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Technical Note 234

SOVIET RESEARCH IN FIELD EMISSION, 1960-1963; AN ANNOTATED BIBLIOGRAPHY

T. W. MARTON AND R. KLEIN

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Tibor W. Marton and Ralph Klein

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SOVIET RESEARCH IN FIELD EMISSION, 1960 - 1963; AN ANNOTATED BIBLIOGRAPHY*

TIBOR W. MARTON and RALPH KLEIN

Soviet field emission research, including both the experimental and theoretical aspects of field electron and ion emission from metals and semiconductors, is the subject of this bibliography. Over 80 complete references to original publications and 50 meeting papers were selected after an extensive search of the Soviet and East European technical literature published from January 1960 through November 1963. Most of these papers are in Russian; a few are in Czech, English, Hungarian, Polish, and Ukrainian. Full references are given to English translations of the entries whenever available. A list of relevant scientific meetings, papers read at these meetings, bibliographic references, and a brief subject index are appended to the compilation. This bibliography represents the continuation of the survey[1] published in October 1960 as U.S. NBS Technical Note 75.

1. INTRODUCTION

1.1 Purpose and scope. Field emission research continues to receive considerable attention in the Soviet Union, as evidenced by the fairly large number of technical papers (over 80) appearing since 1959. The previous bibliographic survey[1] of the Soviet literature pertinent to field emission covered the period 1955-1959, and contained 109 entries. This included several papers presented at technical meetings. In the present survey, the meeting papers have been tabulated separately, and again, the relatively large number of meetings, either wholly or in part dealing with field emission topics, is an indication of the lively interest field emission continues to hold.

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* This project was supported in part by the Advanced Research Projects Agency.

[1] Marton, T.W. and Klein, R. Soviet Research in Field Electron and Ion Emission, 1955-1959; an Annotated Bibliography. U.S. National Bureau of Standards, Technical Note 75, October 1960. 37p. Distributed by U.S. Department of Commerce, Office of Technical Services (PB 161576), Washington, D.C. 20230.

The range of subjects covered is fairly broad. Both experimental and theoretical papers have appeared. Field electron emission from semiconductors and from metals other than tungsten is well represented. Studies of adsorption with the field emission technique, methods of tip etching, pulse methods, and the pre-breakdown region have been reported. Several papers are concerned with the measurement of emitted electron energy distribution. A new theory of molecular image formation has been advanced, and theoretical considerations of the effects of space charge, electron tunneling,and field and T-F emission from metals and semiconductors are given. The preponderance of effort has been in field electron emission; field ion emission was the basis for three papers during the period of the present survey.

As a continuation of the annotated bibliography covering Soviet research in field emission for the period 1955-1959, the present survey, 1960-1963, maintains the previously stated purpose of bringing to the attention of the scientific community the Soviet and East European literature on field emission. Brief annotations are again provided to indicate the scope of the article, and no critical evaluation is intended.

1.2 Literature search. An extensive search was made of the original Soviet and East European technical literature published from January 1960 through November 1963 for the purpose of selecting papers relevant to field emission research. A few articles issued prior to 1960 have also been included provided they were not listed in the previous Field Emission Bibliography (NBS Technical Note 75). More than four hundred original periodical articles and books were examined and analyzed; out of these, over eighty original papers and fifty meeting paper references were selected for inclusion. About ninety per cent of the entries in this compilation are publications originally written in Russian; the rest are references to Czech, English, Hungarian, Polish, and Ukrainian papers.

1.3 Entries and arrangement. With few exceptions, entries in this bibliography consist of author(s), original and translated title, abbreviated name of the periodical, collation, and citations of available English translation.

The entries are arranged alphabetically by the name of the first author, and then by coauthor(s) if any. Two or more papers by the same author(s) are listed chronologically, beginning with the earliest paper.

a) Titles of papers. To ensure accurate reference identification, the titles are listed in the language of publication. The Library of Congress transliteration system for Cyrillic alphabets has been used throughout. English translation, in parentheses, follows the foreign language title.

b) Abbreviations of citations. Names of periodicals have been abbreviated in accordance with the Chemical Abstracts List of Periodicals, the Style Manual of the American Institute of Physics, and the Publications and Reports Manual of the National Bureau of Standards.

c) Collation. The abbreviated name of periodicals is followed by the volume and issue numbers, inclusive pages, year, and indication of illustrations and references, if any; for instance, 24, no.3, 165-80 (1960). Illus, 6 refs. The slight deviation from citation practice followed by the American Institute of Physics, National Bureau of Standards, and Chemical Abstracts publications was necessitated by the inconsistencies prevalent in citations of Russian periodicals and their cover-to-cover translations. The language of the original publications is noted in brackets at the end of the citation for periodical articles only if the article was published in a language other than Russian.

d) Unpublished papers. Papers read at seminars and symposia for which no separate publication was found in the open literature, but which were reviewed or summarized in meeting transactions or announcements, are listed on pages 29-37.

e) Translations. To aid readers lacking a reading knowledge of the languages represented in this bibliography, an attempt has been made to give full references to available English translations and to summaries. These citations -- very often references to cover-to-cover translation journals -- are indicated in the entry by "English translation."

f) Annotations. Summaries generally have been made as brief as possible, touching only on the salient points. References to related papers, subjects, or relevant meetings are denoted by "see also" or "see", respectively.

1.4 Sources of translations. The majority of Soviet field emission papers are published in a relatively small number of journals, most of which are available in cover-to-cover English translation journals. Such translated journals -- which can usually be found in the larger technical libraries -- are listed as follows: 1a) Radio Engineering and Electronics (Pergamon Press, 1957 - 1960); 1b)Radio Engineering and Electronic Physics (Institute of Electrical and Electronics Engineers, 1961-to date); 2) Soviet Physics-Solid State (American Institute of Physics); 3) Soviet Physics-Doklady (American Institute of Physics);4)Soviet Physics-Technical Physics (American Institute of Physics); 5) Bulletin of the Academy of Sciences, USSR, Physical Series (Columbia Technical Translations).

For English translations of entries not available or not located by the time this bibliography was completed, the reader may wish to check with the following translation centers: U.S. Department of

Commerce, Office of Technical Services, Washington, D.C. 20230 (OTS - PB and LC numbers), the Special Libraries Association's Translation Center at the John Crerar Library, 35 West 33rd Street, Chicago, Illinois 60616, and the National Lending Library for Science and Technology, Boston Spa, Yorkshire, England.

1.5 Conclusion. Although an attempt was made to record as many Soviet and East European papers as possible, the compilation does not claim to be all-inclusive. A number of original sources, especially dissertations and patents, and some periodicals could not be located by the time set for the bibliography's completion. It is hoped that these gaps may be filled in a future supplement or cumulative issue which will also cover further developments in Soviet field emission research. The compilers will welcome suggestions for improvement and information on any significant paper which may have been overlooked in this bibliography.

For the convenience of readers, scientific conferences relevant to field emission research, together with papers read at these meetings, are listed on pages 29-37. Addenda, references to bibliographic aids in this subject area, and a brief subject index are appended to the compilation.

2. ANNOTATED BIBLIOGRAPHY

1. AIZENBERG, N.B. Prokhozhdenie elektronov cherez priamougol'nyi potentsial'nyi bar'er s maloi tsilindricheskoi neodnorodnost'iu. (Passage of electrons through a rectangular potential barrier with small cylindrical inhomogeneities). Fiz. Tverd. Tela, 2, no.6, 1178-85 (1960). Illus, 2 refs. English translation: Soviet Phys. - Solid State, 2, no.6, 1067-74 (1960).

   The problem of electron tunneling through a rectangular potential barrier perturbed by a cylindrical region of a slightly lowered work function is considered. A numerical example is given to show the effect of angle of incidence of the electron on the barrier with respect to the transmission coefficient. It is also shown that the perturbation of the wave function extends beyond the limits of the cylindrical region.

2. ALPATOVA, N.M. Elektrokhimicheskie metody polucheniia eksperimental'nykh avtoelektronnykh emitterov razlichnoi konfiguratsii iz karbida tsirkoniia, germaniia i vol'frama. (Electrochemical methods of obtaining experimental field emitters of various shapes from zirconium, germanium, and tungsten carbides). Radiotekhn. i Elektron, 5, no.8, 1351-5 (1960). Illus, 7 refs. Radio Eng. Electron. USSR, 5, no.8, 243-50 (1960).

   The characteristics of the electrolytic etching of zirconium, germanium and tungsten carbides were obtained. Solutions used were KOH, HNO_3 + Na_2SiF_6, HNO_3 + HCl, CP-4, HF, KF. Voltages were varied from 1 to 200 v. Both static and pulse methods were investigated.

3. ECKERTOVA, L. Autoemise z tenkych dielektrickych vrstev. (Field emission from thin dielectric layers). Cesk. Casopis Fys, A10, no.5, 412-9 (1960). [In Czech with English summary].

   General concepts of the mechanism of field emission from thin dielectric layers and experimental methods for the production and study of field emission are described. A relationship between this phenomenon and discharges in high vacuum is given and emitter characteristics are evaluated.

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4. ECKERTOVA, L. Poznamky k ceské terminologii v oboru emise elektronu. (Notes on Czech terminology in the field of electron emission). Cesk. Casopis Fys, A12, nos.5-6, 596-7 (1962). ⌈In Czech⌉.

Czech terms related to field emission are defined, and a classification scheme for various cathodes is given.

5. ECKERTOVA, L. and MASEK, K. Vremennaiia zavisimost' avtoelektronnogo toka v elektronnom proektore. (Time dependence of the field emission current in a field emission microscope). Radiotekhn. i Elektron, 5, no. 8, 1351 (1960). English translation: Radio Eng. Electron. USSR, 5, no.8, 242 (1960).

An increase in emission current, extending over several seconds, was observed after the initial application of voltage to the tube. Adsorption, desorption and ion bombardment of the point are probably involved.

6. ELINSON, M.I., DOBRIAKOVA, F.F., KRAPIVIN, V.F., and others. O teorii avtoelektronnoi i termoavtoelektronnoi emissii metallov i poluprovodnikov. (Theory of field and thermal field emission of metals and semiconductors). Radiotekhn. i Elektron, 6, no. 8,1342-53 (1961). Illus, 14 refs. English translation: Radio Eng. Electron. Phys. USSR, 6, no.8, 1191-200 (1961).

Numerical calculations are given for the density of the field-emission and thermionic-field-emission currents. The energy distribution of the emitted electrons for metals and semiconductors, using a new expression for the penetration of the surface barrier over a wide range of parameters, is calculated.The results differ from those previously obtained for metals on the basis of the WKB method. The calculations were extended to the case of semiconductors,purposely omitting considerations of field penetration and surface states.

7. ELINSON, M.I. and GOR'KOV, V.A. Nekotorye osobennosti raboty avtoelektronnykh katodov v elektricheskikh poliakh SVCH. (Some special features of field-emission cathode operation in microwave fields). Radiotekhn. i Elektron, 6, no.2, 336-9 (1961). Illus, 3 refs. English translation: Radio Eng. Electron. Phys. USSR, 6, no.2, 294-7, (1961).

The operation of a field-emitting cathode in microwave fields is discussed. The space charge in the electron packet at various distances from the resonator is calculated. It is also shown that in such devices cathode sputtering is substantially reduced.

8. ELINSON, M.I. and GOR'KOV, V.A. Avtorskoe svidetel'stvo (Author's certificate no. 18430, May 27, 1958 (Priority: January 16, 1958).

Description or exact title of this patent was not available at the time of the compilation of this bibliography.

9. ELINSON,M.I., GOR'KOV,V.A., IASNOPOL'SKAIA, A.A.and KUDINTSEVA,G.A. Issledovaniia impul'snoi avtoelektronnoi emissii pri vysokikh plotnostiakh tokov. (Investigation of pulsed field emission at high current densities). Radiotekhn. i Elektron. USSR, 5, no.8, 1318-26 (1960). Illus, 9 refs. English translation: Radio Eng. Electron. USSR, 5, no.8, 185-9 (1960).

Pulsed field emission from tungsten, LaB_6 and ZrC tips has been studied. Appreciable deviation of the shape of the characteristic $\ln I = f\ (1/E)$ curve in the region of reduced current densities has been found. A strong dependence of the limiting (pre-breakdown) current density on the cone angle of the point has been established. Additional evidence has been obtained to support the explanation of the deviation of the current-voltage characteristics from theory on the basis of the space charge concept.

10. ELINSON, M.I. and KUDINTSEVA, G.A. Avtoelektronnye katody na osnove metallopodobnykh tugoplavkikh soedinenii. (Field emission cathodes using metallic refractory compounds). Radiotekhn. i Elektron, 7, no.9, 1511-8 (1962). Illus, 8 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no.9, 1417-23 (1962).

Certain metallic refractory compounds such as ZrC, LaB_6, and TiC have been prepared and used as field emitters. ZrC and LaB_6 show increased stability to ion bombardment over that of tungsten. LaB_6 thermionic cathodes with flat surfaces were prepared and tested.

11. ELINSON, M.I., SANDOMIRSKII, V.B., GOR'KOV, V.A., and ZHDAN, A.G. Otvet na pis'mo v redaktsiiu G.N. Shuppe, A.S. Kompaneetsa " O stat"e V.A. Gor'kova:Pervyi Simpozium po avtoelektronnoi emissii ." (Reply to the letter from G.N. Shuppe and A.S. Kompaneets to the editor "Concerning V.A. Gor'kov's report on the First Symposium on Field Emission.") Radiotekhn. i Elektron, 7 , no. 9, 1686-8 (1962). Illus, 4 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no.9, 1570-2 (1962).

This is a short discussion of the role of space charge and its expected effect on the deviation of linearity of the Fowler-Nordheim plot at high current densities. (See entry # 3.4, pp. 31-3).

12. ELINSON, M.I. and ZHDAN, A.G. Kholodnaia emissiia elektronov iz tonkikh sloev SiO_2 + C na vol'frame. (Field emission of electrons from thin layers of SiO_2 + C on tungsten). Radiotekhn. i Elektron, 5, no.11, 1862-5 (1960). Illus, 6 refs. English translation: Radio Eng. Electron. USSR, 5, no.11, 175-81 (1960).

Field emission observations were made of thin layers of quartz, activated by carbon, on tungsten. The form of the relationship of the emitted current to the field and to the temperature of the layer agrees with the theoretical concept of emission of "hot" electrons. The heterogeneous distribution of emission on the surface and of its sensitivity to the technique of producing the layer was noted.

13. ELINSON, M.I., ZHDAN, A.G., and VASIL'EV, G.F. Ob interpretatsii khoda vol'tampernykh kharakteristik avtoelektronnoi emissii poluprovodnikov. (Interpretation of the current-voltage characteristics of field emission from semiconductors). Radiotekhn. i Elektron, 5, no.12, 2004-8 (1960). Illus, 6 refs. English translation: Radio Eng. Electron. USSR, 5, no.12, 192-9 (1960).

The current-voltage characteristics of SiO_2 — C and Al_2O_3—W field emitters were obtained. Observations with interpretations were made on other semiconductors.

14. ERNST, L. Examination of tantalum monocrystal tips by means of a field emission microscope. Acta Phys. Acad. Sci. Hung, 13, no.2, 169-82 (1961). Illus, 16 refs. ⌊In English⌋.

Field emission from tantalum emitters was studied. The patterns were characterized by the absence of the 112 planes. Built up patterns were obtained by heating while the field was applied. Twin crystals and impurity effects were also noted.

15. FURSEI, G.N. Avtoelektronnaia emissiia s monokristallov vol'frama, predshestvuiushchaia razvitiiu vakuumnoi dugi. (Field emission from tungsten single crystals in the pre-breakdown current region). Radiotekhn. i Elektron, 6, no.2, 298-302 (1961). Illus, 12 refs. English translation: Radio Eng. Electron. Phys. USSR, 6, no. 2, 257-62 (1961).

Field emission in the pre-breakdown region was investigated. The design of the apparatus and the experimental technique was described. The method was that of pulsed emission as in other investigations of this nature, but with some modifications. It was found that there is a deviation of the Fowler-Nordheim relationship at higher voltages in the direction of lower currents.

16. FURSEI, G.N. and TOLKACHEVA, I.D. Bol'shie plotnosti avtoelektronnogo toka i effekty predshestvuiushchie vakuumnomu proboiu, dlia emitterov iz Ta i Mo. (High-density field emission currents and pre-breakdown effects for tantalum and molybdenum emitters). Radiotekhn. i Elektron, 8, no.7, 1210-21 (1963). Illus, 20 refs. English translation: Radio Eng. Electron. Phys, USSR, 8, no.7 (To appear early 1964).

Single crystal tantalum and molybdenum emitters were studied by using a pulsed technique at current densities up to 5×10^7 amp/cm^2. The current-voltage curves showed departure from linearity at low currents. It was found that the pre-breakdown period for Ta and Mo was characterized by a spontaneous change at constant voltages. Rings were observed around the emission pattern when the current density was approaching the critical value.

17. GOFMAN, I.I. Issledovanie elektrostaticheskoi emissii elektronov iz vol'frama v shirokom intervale plotnostei toka. (Investigation of field emission from tungsten in a wide range of current density). Fiz. Tverd. Tela, 4, no.8, 2005-14 (1962). Illus, 17 refs. English translation: Soviet Phys.-Solid State, 4, no.8, 1471-7 (1963).

Emission currents were measured over the range from 10^{-19} to 10^{-1} amps. In the high current region, a pulsed voltage method was used, and in the low current region, measurements were made with scintillation counting. The latter technique is new in field emission work, and the experimental details are described. The Fowler-Nordheim plot is linear over 15 orders of magnitude of current. At very low currents, a departure from linearity was observed.

18. GOFMAN, I.I. Ob elektrostaticheskoi emissii elektronov iz vol'frama v oblasti slabykh polei. (Field emission from tungsten in the weak field region). Dokl. Akad. Nauk Uz.SSR, 1962, no.6, 26-8.

Field emission from tungsten in weak fields was measured by a scintillation technique with a sensitivity of 10^{-18} to 10^{-19} amp. The dependence of the emission in different crystallographic directions was measured. The log of the current showed a linear dependence on l/V, but some anomalies observed need further elucidation.

19. GOFMAN, I.I., PROTOPOPOV, O.D., and SHUPPE, G.N. Issledovanie elektrostaticheskoi emissii elektronov iz vol'framovogo emittera v impul'snom rezhime. (Investigation of pulsed field emission from a tungsten emitter). Fiz. Tverd. Tela, 2, no.6, 1323-7 (1960). Illus, 9 refs. English translation: Soviet Phys.-Solid State, 2, no.6, 1203-8 (1960).

Pulsed field emission was investigated, and some refinements were considered in the interpretation of the experimental results. Some of these were the decrease in the average work function at higher fields because of the greater participation of the low work function areas in emission, and the spherical space charge distribution as opposed to the previously used planar distribution.

20. GOFMAN, I.I., PROTOPOPOV, O.D.and SHUPPE,G.N. Issledovanie elektrostaticheskoi emissii elektronov (EEE) iz vol'framovogo emittera v impul'snom rezhime. (Investigation of pulsed field emission from a tungsten emitter). Izv. Akad. Nauk Uz.SSR, Ser.Fiz.Mat.Nauk, 1959, no.6, 72-7. Illus, 6 refs.

For annotation, see preceding entry.

21. GOR'KOV, V.A., ELINSON, M.I., and IAKOVLEVA, G.D. Teoreticheskoe i eksperimental'noe issledovaniia preddugovykh iavlenii pri avtoelektronnoi emissii. (Theoretical and experimental investigation of pre-arc phenomena in field emission). Radiotekhn. i Elektron, 7, no.9, 1501-10 (1962). Illus, 8 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no.9, 1409-17 (1962).

The variations of the resistivity, specific heat, and radiation factor with temperature were taken into account to develop a more rigorous treatment of field emission in the region just before high field breakdown. Experimental data were compared with theory, and good agreement was found.

22. GOR'KOV, V.A., ELINSON, M.I., and SANDOMIRSKII, V.B. O roli prostranstvennogo zariada pri otbore avtoelektronnykh tokov bol'shoi plotnosti. (Space charge effects in high-density field emission). Radiotekhn. i Elektron, 7, no.9, 1495-500 (1962). Illus, 7 refs.

English translation: Radio Eng. Electron. Phys. USSR, 7, no.9, 1404-8 (1962).

It is shown that when an emitter-anode region of a sufficient positive space charge is produced (for example, from ionized residual gas molecules), the compensating action of the space charge should lead to a definite type of departure of the current-voltage characteristics.The qualitative agreement between the experimental and calculated curves indicates the dominant role of electron space charge.

23. HAJEK, Z. and ECKERTOVA, L. Die Konstruktion einer stabilen Feldkathode. (Stable field emission cathode design). Naturwissenschaften, 49, no.9, 201 (1962). [In German].

Stable field cathodes of the type $Al-Al_2O_3-Me$ where Me is a metal such as Ag, Au, Pt, etc.are described.

24. KAUFMAN, M.S. and IANKIN, G.M. Elektronnye pribory. (Electron devices). 2nd rev. ed. Moscow, Gosenergizdat, 1960. 546 p. Illus.

This textbook contains a brief description of the theory of field emission, in Section 3-5, pp.60-3.

25. KLIMIN, A.I. Izuchenie avtoelektronnoi emissii s sul'fida kadmiia, selenida kadmiia i germaniia v elektronnom proektore. (Field emission microscope study of cadmium sulfide, cadmium selenide and germanium). Dissertatsia Kandidata fiz.-mat.nauk, Leningr. Gos. Univ, (1960). (Dissertation, Leningrad State Univ., 1960).

This dissertation was not available at the time of the compilation of this bibliography.

26. KLIMIN, A.I., SEDYKH, B.N., and SOKOL'SKAIA, I.L. O nekotorykh zakonomernostiakh avtoelektronnoi emissii s poluprovodnikov. (On the characteristics of field emission from semiconductors). Fiz. Tverd. Tela, 2, no.8, 1851-6 (1960). Illus, 7 refs.English translation: Soviet Phys.-Solid State, 2, no.8, 1673-7 (1961).

The dependence of the field-emission current from germanium on field intensity was investigated. It is shown that the temperature dependence of the field-emission current is determined by an increased electron concentration in the surface layer of semiconductors due to field penetration. The experimental results agree with the theory of field emission

from semiconductors for the case when surface states are relatively unimportant.

27. KOMAR, A.P. and KOMAR, A.A. Molekuly i kompleksy molekul i atomov kak volnovody elektronnykh voln. (Molecules, molecular complexes, and atoms as wave guides for electron waves). Zh. Tekhn. Fiz, 31, no.2, 231-7 (1961). Illus, 15 refs. English translation: Soviet Phys.-Tech. Phys, 6, no.2, 166-70 (1961).

The "molecular image" formation in the field emission microscope is explained on the basis of waveguide theory. A molecular complex with dimensions greater in the radial than the transverse direction is required. Cylindrical symmetry is assumed. The boundary condition at the cylindrical surface of the complex yields solutions that give doublet and quadruplet forms as observed.

28. KOMAR, A.P. and KOMAR, A.A. K teorii volnovodnykh svoistv metallopodobnykh molekul i ikh kompleksov. (On the theory of the waveguide properties of metal-like molecules and their complexes). Zh. Tekhn. Fiz, 32, no.7, 867-73 (1962). Illus, 8 refs. English translation: Soviet Phys.-Tech. Phys, 7, no.7, 634-7 (1963).

Further considerations of the mechanism of the formation of "molecular images" in the field emission microscope are given. The waveguide theory, developed previously, is extended to include penetration of the external field into the interior of the molecular whiskers and its effect on the movement of electrons.

29. KOMAR, A.P. and SAVCHENKO, V.P. Vliianie primesei i dislokatsii na avtoelektronnuiu emissiiu metallicheskikh kristallov. (Effect of impurities and dislocations on field emission from metals). Fiz. Tverd. Tela, 4, no.5, 1346-51 (1962). Illus, 12 refs. English translation: Soviet Phys.-Solid State, 4, no.5, 986-92 (1962).

Field emission patterns were obtained for Pt, Ag, and Cu. It is shown that high temperatures cause impurities to appear. This process is associated with dislocations and defects. In general, these impurities lower the work function of the surface. They may be field evaporated.

30. KOMAR, A.P., SAVCHENKO, V.P., and SHREDNIK, V.N. Novyi metod izgotovleniia avtoelektronnykh emitterov iz legkoplavkikh metallov i splavov. (New method of preparing field emitters of non-refractory metals and alloys). Radiotekhn. i Elektron, 5, no.8,1342-6 (1960). Illus, 7 refs. English translation: Radio Eng. Electron. USSR, 5, no.8, 226-32 (1960).

A new method of preparing field emitters is suggested. This involves local breakdown in high fields. Complete breakdown is retarded by strong feedback. The technique is used to prepare clean surfaces without the necessity of strong heating which may, in the case of less refractory materials, lead to excessively blunt tips. The method is illustrated with Au, Ag, Cu, and the alloys Ni_3Mn, Cu_3Pt, and Cu_3Au.

31. KOMAR, A.P., SAVCHENKO, V.P., and SHREDNIK, V.N. Adsorbtsiia migratsiia i isparenie Be, napylennogo na monokristall W. (Adsorption, migration and evaporation of Be deposited on W single crystals). Radiotekhn. i Elektron, 5, no.8, 1211-7 (1960). Illus, 19 refs. English translation: Radio Eng. Electron. USSR, 5, no.8, 22-31 (1960).

The adsorption and migration characteristics of beryllium on tungsten have been studied with the field emission microscope. The work function of a massive deposit of Be was measured as 5 ev. A monolayer showed 4.1 ev. The activation energy for migration is in the sequence $Q(110) < Q(112) < Q(111)$. The order of decreasing rate of evaporation is (111), (110), (112) and (100).

32. KOMAR, A.P. and SHREDNIK, V.N. Atomnaia struktura mikrokristallov W s razmerami do 60 Å. (Atomic structure of W single crystals with dimensions to 60 Å). Dokl. Akad. Nauk SSSR, 144,no.3, 541-3 (1962). Illus, 4 refs. English translation: Soviet Phys. "Doklady", 7, no.5, 425-7 (1962).

Field ion patterns of a tungsten tip with a protuberance formed by a vacuum breakdown were obtained. It was estimated that the protuberance was about 60 atoms in diameter, and the field ion pictures made with helium at $63^{o}K$, showed (110), (011), (211) and (121) planes clearly.

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33. KOMAR, A.P. and SIUTKIN, N.N. "Goriachee" starenie i vozvrat v splave Ni-Be po nabliudeniiam v avtoemissionnom elektronnom mikroskope.(Field emission microscope observations on the thermal aging and recovery of Ni-Be alloys). Dokl. Akad. Nauk SSSR, 150, no.5, 1029-31 (1963). Illus, 6 refs. English translation: Soviet Phys. "Doklady" (To appear early 1964).

Field emission patterns from an emitter of Ni + 1% Be alloy were obtained in the region of 200 - 900°C. A new phase, evidenced by bright spots on the pattern, appeared at 200°C. Their number and size increased with temperature to a maximum, then decreased, disappearing completely at 900°C. The spot patterns are ascribed to local work function changes.

34. KOMAR, A.P., TALANIN, IU.N. and CHERNIAVSKAIA, N.A. Tezisy pervogo simpoziuma po elektrostaticheskoi emissiia elektronov. (Proceedings of the First Symposium on Field Emission). Tashkend, Izd. SAGU, 1960.

This publication, cited as a reference in paper#29, was not available at the time of the compilation of this bibliography. (See also entry # 3.4, pp. 31-3).

35. KOMPANEETS, A.S. Vliiianie ob"emnogo zariada na avtoelektronnuiu emissiiu. (Influence of space charge on field emission). Radiotekhn. i Elektron, 5, no.8, 1315-7 (1960). 4 refs. English translation: Radio Eng. Electron. USSR, 5, no.8, 180-4 (1960).

In the usual consideration of electron transmission through the potential barrier in the field emission case, the image force factor is calculated classically. This is shown to be incorrect, and the appropriate treatment using the wave equation in conjunction with Poisson's equation is given. The correction in current for a spherical space charge configuration amounts to 10 to 15 per cent.

36. MAKUKHA, V.I. Adsorbtsiia kal'tsiia na vol'frame. (Adsorption of calcium on tungsten). Radiotekhn. i Elektron, 6, no.2, 339-41 (1961). Illus, 10 refs. English translation: Radio Eng.Electron. Phys. USSR, 6, no.2, 298-301 (1961).

Calcium on tungsten was investigated with a field emission microscope. The deposition time versus work function curve shows a minimum at 2.4 ev. Migration commences at 400°C and evaporation at 700°C.

The order of adsorption bond strength on various planes appears to be in the sequence (111), (112), (100) and (110).

37. MAKUKHA, V.I. Adsorbtsiia strontsiia na vol'frame. (Adsorption of strontium on tungsten). Radiotekhn. i Elektron, 6, no.2, 342-3 (1961). Illus, 4 refs. English translation: Radio Eng. Electron. Phys. USSR, 6, no.2, 301-4 (1961).

The curve of the variation of work function with time shows a minimum. Migration of the strontium begins at 450-500°C and desorption at 750-800°C. The Sr crystals initially formed on tungsten disappear at about 400°C.

38. MAKUKHA, V.I. Avtoelektronnaia emissiia iridiia. (Field emission from iridium). Radiotekhn. i Elektron, 7, no.5, 900-3 (1962). Illus, 9 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no.5, 851-4 (1962).

Field emission from iridium tips has been studied, and methods of tip etching are described. The areas of low emission on the pattern are ascribed to the (111), (100), and the (110) planes. The (113) and (103) planes are also observed.

39. MAKUKHA, V.I. Avtoelektronnaia emissiia rodiia. (Field emission of rhodium). Radiotekhn. i Elektron, 8, no.2, 352-4 (1963). Illus, 3 refs. English translation: Radio Eng. Electron. Phys. USSR, 8, no.2, 310-2 (1963).

Field emission patterns were obtained using a rhodium emitter. The preparation of the tip and indexing of the low emitting areas are described.

40. NAUMOVETS, A.G. Sposterezhennia avtodesorbtsii zalyshkovikh gaziv z vol'framu v avtoionnomu proektori. (Field ion microscope study of self-desorption of residual gases from tungsten). Ukr. Fiz. Zh, 6, no.5, 703-5 (1961). Illus, 5 refs. [In Ukrainian].

Field ion microscopy was used to observe the desorption of residual gases from a tungsten tip. Some foreign atoms remained even up to fields where field desorption was commencing at lattice edges.

41. NAUMOVETS, A.G. Desorbtsiia molekul okisu bariiu z vol'framu v sil'nomu elektrichnomu poli. (Desorption of barium oxide molecules from tungsten in a strong electric field). Ukr. Fiz. Zh, 8, no.1, 65-73 (1963). Illus, 16 refs. [In Ukrainian with English summary].

Desorption of BaO and Ba from W in a strong electric field was studied at 80-1200°K. The field-temperature desorption characteristics of BaO were very similar to those of Ba; interpretation of the data was attempted on the basis of ionic evaporation over a Schottky barrier. Ba was desorbed by the field as Ba+ at 80-300°K and as Ba++ at 300-1000°K; BaO was desorbed as BaO+ at 80-400°K and as BaO++ at 500-1100°K.

42. NIKLIBORC, J. Prace Katedry Fizyki doswiadczalnej Uniwersytetu Wroclawskiego nad emisja polowa elektronow z metali.(Field emission research at the Department of Physics of the Wroclaw University). Sprawozdania Wroclaw. Towarz. Nauk, Ser. B16, 13-7 (1961-2). Illus, 13 refs. [In Polish].

Phenomena related to field emission, such as surface diffusion on nickel and iron and also adsorption and desorption of Ge and Sr on W, were studied. Typical field emission patterns and a list of relevant publications of the above University Department complete the paper.

43. NOIMANN, Kh. K teorii avtoelektronnoi emissii metalla, pokrytogo tonkim sloem poluprovodnika. (Theory of field emission from metals covered with thin semiconductor layers). Fiz. Tverd. Tela, 3, no.11, 3395-9 (1961). Illus, 5 refs. English translation: Soviet Phys.-Solid State, 3, no.11, 2466-8 (1962).

On the assumption that the potential at the surface of a metallic emitter covered with a thin layer of semiconductor can be described as the potential of the pure metal plus an additional potential barrier, the field-emission current is calculated as a function of the height and width of the additional barrier; a numerical solution is obtained for a special case.

44. NOVIKOV, B.V., SOKOL'SKAIA, I.L. and SHCHERBAKOV, G.P. Tonkaia struktura spektral'noi zavisimosti avtoelektronnoi emissii s monokristallov CdS. (Fine structure of the spectrum of field emission from CdS single crystals). Fiz. Tverd. Tela, 4, no.11, 3240-3 (1962). Illus, 14 refs. English translation: Soviet Phys.-Solid State, 4, no.11, 2372-4 (1963).

Field emission current as a function of wave length of incident light was determined for CdS emitters. The fine structure showed minima coincident with exciton adsorption lines. The spectra of photoconductivity were qualitatively similar to that for field emission.

45. PROTOPOPOV, O.D. and SMIRNOV, B.G. Vliianie kremniia i germaniia na elektronnuiu emissiiu s monokristalla vol'frama.(Effect of silicon and germanium on electron emission from tungsten single crystals). Dokl. Akad. Nauk Uz.SSR, 1960, no.6, 38-40.

Silicon and germanium on tungsten were studied with the field emission microscope. The field emission patterns showed collar formation around (110), (121) and (100) analogous to that for tungsten on tungsten in the same temperature interval. Covering the surface with Si or Ge shows little effect on emission current.

46. ROGINSKII, S.Z. and SHISHKIN, V.A. Issledovanie adsorbtsii nepredel'nykh ftoruglerodov C_2F_4 i C_3F_6 v elektronnom proektore. (Field emission microscope study of adsorption of the unsaturated fluorocarbons C_2F_4 and C_3F_6). Dokl. Akad. Nauk SSSR, 130, no.3, 577-80 (1960). Illus, 6 refs. English translation: Proc. Acad. Sci.USSR, Phys. Chem. Sect, 130, 71-4 (1960).

This work is concerned with molecular images formed from C_2F_4 and C_3F_6. The fluorocarbons were used to avoid the hydrogen split-off that may occur in the case of hydrocarbons. It is hypothesized that π bonds participate in the image formation although the data are not conclusive.

47. SHCHERBAKOV, G.P. and SOKOL'SKAIA, I.L. Eksperimental'noe izuchenie raspredeleniia avtoelektronov s monokristallov CdS. (Experimental study of the energy distribution of field emission electrons from CdS single crystals). Fiz. Tverd. Tela, 4, no.12, 3526-36 (1962). Illus, 7 refs. English translation: Soviet Phys.-Solid State, 4, no.12, 2581-8 (1963).

The electron energy distribution for CdS was determined. Increasing the field leads to heating of the electron gas. Carriers are generated when the width of the energy distribution coincides approximately with the width of the forbidden band in CdS. Higher emitter temperatures lead to broadening of the energy distribution.

48. SHISHKIN, V.A. Vliianie poverkhnosti na formu i povedenie molekuliarnykh kartin. (Effect of the surface on the shape and behavior of molecular images). Dokl. Akad. Nauk SSSR, 141, no.6, 1420-2 (1961). Illus, 7 refs. English translation: Proc. Acad. Sci.USSR, Phys. Chem. Sect, 141, 986-8 (1961).

Further considerations of molecular images obtained under certain conditions and with certain substances in the field electron microscope are given. Evidence is presented to show that the molecular images are the same regardless of whether the substrate is a metal, semiconductor or dielectric.

49. SHISHKIN, V.A. and ROGINSKII, S.Z. Vliianie davleniia, temperatury i elektricheskogo polia na povedenie molekuliarnykh kartin. (Effect of temperature, pressure, and electric field on the behavior of molecular images). Dokl. Akad. Nauk SSSR, 143, no.2, 373-6 (1962). Illus, 8 refs. English translation: Proc. Acad. Sci. USSR. Phys. Chem. Sect, 143, 231-4 (1962).

Field emission patterns of CO_2, H_2, and C_3F_6 were studied as functions of pressure, electric field and temperature.

50. SHREDNIK, V.N. Zavisimost' raboty vykhoda plenochnykh katodov ot stepeni pokrytiia. (Dependence of work function of film cathodes on the extent of coverage). Radiotekhn. i Elektron, 5, no.8, 1203-10 (1960). Illus, 20 refs. English translation: Radio Eng. Electron. USSR, 5, no.8, 10-21 (1960).

For electro-positive adsorbates, such as barium on tungsten, the optimum coverage corresponding to a minimum work function is shown to be equal to 1 and not to 0.7 as previously held. The value of 1 is obtained by defining the extent of coverage as the ratio of the adatom concentration at an edge of the type hkl to that of a monolayer.

51. SHREDNIK, V.N. Issledovanie atomnykh sloev tsirkoniia na graniakh kristalla vol'frama pri pomoshchi elektronnogo i ionnogo proektorov. (Field electron and ion microscope study of atomic layers of zirconium on tungsten). Fiz. Tverd. Tela, 3, no.6, 1750-61 (1961). Illus, 18 refs. English translation: Soviet Phys.-Solid State, 3, no.6, 1268-79 (1961).

Successive observations of adsorbed layers in a field electron and ion microscope were used for the investigation of Zr on W. The emission properties and microstructure (with 10-15 Å resolution) of Zr layers in the (100) regions of W crystals were studied from fractional to multilayer coverage. The work function of a monolayer of Zr on W in the (100) regions is 2.62 ev.

52. SHUPPE, G.N. and KOMPANEETS, A.S. O stat'e V.A. Gor'kova "Pervyi simpozium po avtoelektronnoi emissii." (Concerning V.A. Gor'kov's report on the "First Symposium on Field Emission.") Radiotekhn. i Elektron, 7, no.9, 1686 (1962). English translation: Radio Eng. Electron. Phys. USSR, 7, no.9, 1569 (1962).

This is a letter to the editor criticizing the discussion of G.N. Shuppe contained in the report by V.A. Gor'kov on the First Symposium on Field Emission held in Tashkend. (See entry # 3.4, pp. 31-3).

53. SHUPPE, G.N. and ZAKIROV, N.Z. Zavisimost' adsorbtsii na monokristallakh metallov ot kristallograficheskikh napravlenii. (Dependence of adsorption of metal single crystals on crystallographic orientation). Tr. Sredneaz. Gos. Univ. Fiz. Mat. Nauki, 148, no.20, 45-80 (1959). 37 refs.

This is a review with 37 references of papers published up to 1958, devoted to studies of thermal and field emission of metal single crystals covered with adsorbed layers. An explanation of the emission behavior is advanced in terms of crystal geometry.

54. SIROTENKO, I.G., SPIVAK, G.V., and GROMAN, A. Avtoelektronnaia emissiia iz poluprovodnikovykh nitevidnykh monokristallov-viskersov. (Field emission from semiconductor whiskers). Radiotekhn. i Elektron, 5, no.8, 1348-50 (1960). Illus, 9 refs. English translation: Radio Eng. Electron. USSR, 5, no.8, 236-41 (1960).

Field emission from whiskers of molybdenum and tungsten oxides was observed. Individual spots corresponding to individual whiskers were seen on the screen.

55. SOKOL'SKAIA, I.L. Adsorbtsiia, migratsiia i isparenie kadmiia na vol'frame. (Adsorption, migration and evaporation of cadmium on tungsten). Fiz. Tverd. Tela, 3, no.3, 790-5 (1961). Illus, 4 refs. English translation: Soviet Phys.-Solid State, 3, no.3, 574 - 9 (1961).

The adsorption, migration, and desorption of cadmium was studied with a field emission microscope. The work function of a thick layer of cadmium was found to be 4.1± 0.1 ev. The heat of desorption of cadmium from tungsten was 1.5± 0.1 ev.

56. SOKOL'SKAIA, I.L. Termostimulirovannyi avtoelektronnyi tok s monokristallov CdS. (Thermally stimulated field emission current from CdS single crystals). Fiz. Tverd. Tela, 4, no.11, 3330-2 (1962). Illus, 3 refs. English translation: Soviet Phys.-Solid State, 4, no.11, 2437-8 (1963).

Thermally stimulated field emission current was obtained from CdS after illumination with light having a wave length corresponding to the adsorption band. That is, after illumination was stopped and voltage applied, a burst of current was obtained upon heating the emitter. Under certain assumptions, a trap depth of 0.66 ev for CdS was calculated.

57. SOKOL'SKAIA, I.L. Temperaturnaia zavisimost' avtoelektronnoi emissii sul'fida kadmiia. (Temperature dependence of field emission from cadmium sulfide). Fiz. Tverd. Tela, 4, no.11, 3332-4 (1962). Illus, 4 refs. English translation: Soviet Phys.-Solid State, 4, no.11, 2439-40 (1963).

The emitter temperature was determined from the shift of the optical adsorption edge. Two types of temperature effect were observed. The first is ascribed to proportionality of the current to carrier density and absence of temperature effect on band curvature, and the second to the presence of a temperature effect on the band curvature.

58. SOKOL'SKAIA, I.L. and FURSEI, G.N. Izuchenie iavlenii,predshestvuiushchikh razrusheniiu vol'framovykh emitterov impul'sami avtoelektronnogo toka bol'shoi plotnosti. (Study of pre-breakdown phenomena of tungsten emitters by means of high-density field emission pulses). Radiotekhn. i Elektron, 7, no.9, 1474-83 (1962). Illus, 8 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no.9, 1387-94 (1962).

The field emission of tungsten emitters at field current densities of the order of 10^8 amp/cm^2 has been studied by the pulse method (pulse duration 1-4 μ sec). The design of the experimental device makes possible a measurement of current from different sections of the emitter surface. Experimental evidence of the heating of the emitter by the field current in the pre-arc period, and of the appearance of space charge causing cessation of growth of current during the pulsing is given. The pre-arc processes are reversible and reproducible up to the critical current density. The emitter breakdown occurs during a time shorter than 1 μ sec.

59. SOKOL'SKAIA, I.L. and FURSEI, G.N. Vliianie razlichnykh pokrytii na kharakter iavlenii, predshestvuiushchikh razrusheniiu vol'framovykh emitterov impul'sami avtoelektronnogo toka bol'shoi plotnosti. (Effect of various coatings on pre-breakdown phenomena of tungsten emitters due to high-density pulsed field emission currents). Radiotekhn. i Elektron, 7, no.9, 1484-94 (1962). Illus, 5 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no. 9, 1395-403 (1962).

The effect of surface layers in the pre-arc region of large field current densities was studied. Barium increased the space charge, presumably because of its lowering of the work function of the emitter. The thermionic emission in the pre-breakdown region was enhanced. Barium shadowed points were unchanged up to current densities close to the critical value. Above these, the barium spread. Oscillations in the volt-ampere characteristics above the linear region were observed.

60. SOKOL'SKAIA, I.L. and KLIMIN, A.I. Avtoelektronnaia emissiia s sul'fida i selenida kadmiia. I. Zavisimost' ot elektricheskogo polia i temperatury. (Field emission from CdS and CdSe. Pt. 1. Effect of electric field and temperature). Vestn. Leningr. Univ, Ser. Fiz. i Khim, 16, no.4, 34-41 (1961). Illus, 11 refs.

The curve in the current-voltage characteristics of field emission from CdS and CdSe is related to several emitting edges. Field emission increases strongly with temperature, and is reversible up to 400°. Above this temperature, evolution of Cd and irreversible changes in emission occur.

61. SOKOL'SKAIA, I.L. and KLIMIN, A.I. Avtoelektronnaia emissiia s sul'fida i selenida kadmiia. II. Vliianie osveshcheniia. (Field emission from CdS and CdSe. Pt. 2. Effect of illumination). Vestn. Leningr. Univ, Ser. Fiz. i Khim, 16, no.4, 42-50 (1961). Illus, 12 refs.

The effect of illumination of a CdS emitter on its field emission is in agreement with the corresponding data on photoconductivity. A proportionality between the field emission current and the stationary concentration of free carriers in the emitter is indicated. The absence of degeneracy of the electron gas is also shown.

62. SOKOL'SKAIA, I.L. and MILESHKINA, N.V. Avtoelektronnaia emissiia s tonkikh sloev germaniia na vol'frame. (Field emission from thin layers of germanium on tungsten). Fiz. Tverd. Tela, 3, no.11, 3389-94 (1961). Illus, 7 refs. English translation: Soviet Phys.-Solid State, 3, no.11, 2460-5 (1962).

Field emission from thin layers of germanium condensed on a tungsten tip was observed. The germanium layer migrates as an unbroken film, and decreases the emission. This lowering of emission is not accompanied by an increase of the work function. The specific contact properties of a very thin layer of a semiconductor with a metal are involved.

63. SOKOL'SKAIA, I.L. and SHCHERBAKOV, G.P. Izuchenie effektov sil'nogo polia v avtoelektronnykh emitterakh-kristallakh sul'fida kadmiia. (Study of strong field effects in cadmium sulfide field emitters). Fiz. Tverd. Tela, 3, no.1, 167-75 (1961). Illus, 9 refs. English translation: Soviet Phys.-Solid State, 3, no.1, 120-6 (1961).

Field emission from CdS was investigated to determine the effect of voltage drop in the emitter on the characteristics of current voltage curves. The voltage distribution between emitter and vacuum space was determined by a voltage probe and a retarding potential analyzer. It was concluded that although the voltage drop at the emitter can reach substantial values, particularly at low temperatures, its effect on the characteristic emission curves is unimportant.

64. SOKOL'SKAIA, I.L. and SHCHERBAKOV, G.P. Eksperimental'naia proverka prichin nelineinosti vol'tampernykh kharakteristik avtoelektronnogo toka s monokristallov CdS. (Experimental study of the causes of nonlinearity in the Fowler-Nordheim plot of CdS single crystals). Fiz. Tverd. Tela, 4, no.1, 44-51 (1962). Illus, 4 refs. English translation: Soviet Phys.-Solid State, 4, no.1, 31-6 (1962).

The ln I versus 1/V plots for field emission from CdS single crystals over a fairly wide range of currents and voltages are usually non-linear. The curvature in the direction of higher emission in strong fields is associated with an increase in carrier concentration. This is caused by the excitation of additional carriers by the strong internal field. In the medium voltage range the current is proportional to concentration. It has been shown experimentally that the low voltage behavior is due to heating the electron gas in the emitter.

65. TRET'IAKOV, I.I. Issledovanie adsorbtsii gazov na metallakh pri pomoshchi elektronnogo proektora. (Field emission microscope study of gases on metals). Probl. kinetiki i kataliza, Akad. Nauk. SSSR, 1960, no.10, 164-8. Illus, 12 refs.

The molecular image patterns were examined for the following gases adsorbed on tungsten: O, H, N, He, Ne, Ar, CO_2 CCl_4, CH_4, C_2H_6, C_2H_5OH, acetone, C_4H_{10}, C_6H_6, ethylene, acetylene, propylene, butadiene, napthalene, and anthracene.

66. VASIL'EV, G.F. Vliianie formy potentsial'nogo bar'era na granitse emitter-vakuum i raspredeleniia elektricheskogo polia po poverkhnosti emittera na vid vol'tampernykh kharakteristik avtoelektronnoi emissii. (Effect of the form of potential barrier at the emitter-vacuum boundary and of the electric field distribution at the emitter surface on the shape of the current-voltage characteristics of field emission). Radiotekhn. i Elektron, 5, no.11, 1857-61 (1960). Illus, 10 refs. English translation: Radio Eng. Electron. USSR, 5, no.11, 166-74 (1960).

The effect of the form of the potential barrier on the current-voltage characteristics of a field emitter is examined. At fields greater than 5×10^7 v/cm, a new function essentially different from that of Nordheim was found. The correction is associated with the field distribution at the surface of the emitter.

67. VASIL'EV, G.F. Issledovanie elektrostaticheskoi emissii nekotorykh tugoplavkikh soedinenii s poluprovodnikovoi i metallicheskoi provodimost'iu. (Study of field emission from several refractory compounds with semiconductor and metallic conductivity).Dissertatsiia Kandidata Fiz.-Mat. Nauk, Tashkent.Univ. (1960). (Dissertation, Tashkend Univ, 1960).

This dissertation was not available at the time of the compilation of this bibliography.

68. VASIL'EV, G.F. Proniknovenie elektricheskogo polia v poluprovodnik. (Penetration of electric fields into semiconductors). Radiotekhn. i Elektron, 6, no.10, 1741-4 (1961). Illus, 3 refs. English translation: Radio Eng. Electron. Phys. USSR, 6, no.10, 1551-3 (1961).

Formulas are obtained describing the penetration of external electric fields into semiconductors. The calculation is made under the assumption that the temperature of the electrons in semiconductors is equal to the lattice temperature.

69. ZHDAN, A.G. and ELINSON, M.I. Raspredelenie emittirovannykh avtoelektronov po energiiam dlia poluprovodnikov. (Energy distribution of field-emitted electrons in semiconductors). Radiotekhn. i Elektron, 6, no.4, 671-2 (1961). Illus, 3 refs. English translation: Radio Eng. Electron. Phys. USSR, 6, no.4, 595-6 (1961).

The spectral energy distribution for electrons emitted from the semiconductor carbon-activated quartz was determined. The field emission of high-resistance semiconductors is substantially non-equilibrium, and for large internal fields, a considerable number of electrons surmount the potential barrier.

70. ZHDAN, A.G., ELINSON, M.I., and SANDOMIRSKII, V.B. Issledovanie spektrov avtoelektronov, emittirovannykh iz poluprovodnikov. (Investigation of the spectra of field emission electrons emitted from semiconductors). Radiotekhn. i Elektron, 7, no.4, 670 - 86 (1962). Illus, 11 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no.4, 630-45 (1962).

The total energy distribution for a $SiO_2 + C$ emitter was determined as a function of current density and temperature. A strong electric field penetration led to a broadening of the total energy spectra of field emitted electrons. High energy tails, of the order of 10 electron volts, were observed in some cases. The electron gas temperature may reach 10,000 to 15,000°K, which is not depressed by drawing large currents. A Maxwellian distribution appears to be applicable to the field electrons emitted in the high energy region.

71. ZUBENKO, IU.V. Adsorbtsiia, migratsiia i isparenie bariia na karbidirovannom vol'frame. (Adsorption, migration, and evaporation of barium on tungsten carbide). Fiz. Tverd. Tela, 3, no.2, 528-34 (1961). Illus, 10 refs. English translation: Soviet Phys.-Solid State, 3, no.2, 387-91 (1961).

The evaporation of barium from W_2C occurs in three stages. The values for the heats of desorption are given as 3.9, 2.5, and 5.6 ev, and are obtained from Arrhenius plots.

72. ZUBENKO, IU.V. Izuchenie formy monokristallicheskikh emitterov iz karbida vol'frama pri pomoshchi elektronnogo mikroskopa. (Electron microscope study of the shapes of single crystal tungsten carbide emitters). Radiotekhn. i Elektron, 6, no.3, 381-3 (1961). Illus, 7 refs. English translation: Radio Eng. Electron. Phys. USSR, 6, no.3, 338-40 (1961).

Tungsten carbide emitters were prepared by carbiding tungsten emitters in the field emission microscope. The deformation of the emitter tip on carbiding was determined by both optical and electron microscopic examination. The absence of plane facets was noted.

73. ZUBENKO, IU.V. Avtoelektronnaia emissiia sloev titana na vol'frame i karbide vol'frama. (Field emission from titanium layers on tungsten carbide). Radiotekhn. i Elektron, 8, no.7, 1239 - 45 (1963). Illus, 11 refs. English translation: Radio Eng. Electron. Phys. USSR, 8, no.7 (To appear early 1964).

Field emission currents from titanium layers on single crystal tungsten and tungsten carbide tips were studied in a field emission microscope. It was shown that the work function changes "monotonously" with titanium coverage. The rates of evaporation from tungsten or tungsten carbide are similar.

74. ZUBENKO, IU.V. and SOKOL'SKAIA, I.L. Avtoelektronnaia emissiia karbidirovannogo i torirovannogo karbidirovannogo vol'frama.(Field emission from tungsten carbide and thoriated tungsten carbide). Radiotekhn. i Elektron, 5, no.8, 1327-37 (1960). Illus, 17 refs. English translation: Radio Eng. Electron. USSR, 5, no.8, 200-18 (1960).

A W_2C emitter was prepared by heating a W tip in an atmosphere of diffusion pump oil. The adsorption and evaporation of thorium on W_2C was then investigated. The rate of evaporation of thorium from W_2C is less than that from W, although the heats of desorption are the same.

75. ZUBENKO, IU.V. and SOKOL'SKAIA, I.L. Avtoelektronnaia i termoelektronnaia emissiia sloev toriia i bariia na vol'frame. (Field emission and thermionic emission of thorium and barium layers on tungsten). Fiz. Tverd. Tela, 3, no.5, 1561-5 (1961). Illus, 13 refs. English translation: Soviet Phys.-Solid State, 3, no. 5, 1133-6 (1961).

The emission from tungsten was determined as a function of the thickness of deposited thorium and barium layers. The emission increases "monotonously", and no maximum was found. A maximum had previously been ascribed to a monolayer, but this effect is shown to be associated with oxygen chemisorbed from residual gases.

76. ZUBENKO, IU.V. and SOKOL'SKAIA, I.L. O rabote vykhoda karbida vol'frama. (Work function of tungsten carbide). Zh.Tekhn. Fiz, 32, no.3, 378-80 (1962). Illus, 17 refs. English translation: Soviet Phys.-Tech. Phys, 7, no.3, 270-2 (1962).

The work function of W_2C was measured by a Richardson plot on a sample of W_2C wire. The value of 4.58 ± 0.08 ev was found;within the limit of experimental error, this is the same value as that for pure tungsten.

77. ZUBENKO, IU.V. and SOKOL'SKAIA, I.L. Avtoelektronnaia emissiia zolotobarievykh sloev. (Field emission of gold-barium layers). Radiotekhn. i Elektron, 7, no.9, 1467-73 (1962). Illus, 9 refs. English translation: Radio Eng. Electron. Phys. USSR, 7, no.9, 1381-6 (1962).

Gold and barium were deposited on a tungsten field emitter. After heating to $900^{\circ}K$ the compound $BaAu_5$ was assumed to be formed. The work function,derived from Fowler-Nordheim plots, was measured as 3.3 ev, independently of the sequence of deposition. Heating the layer in fields where the emitter is positive or negative with respect to the screen changes the characteristics of the emitter in a reversible way. This is interpreted as a manifestation of the dielectric properties of the gold-barium compound.

2.1 ADDENDA

The following papers became available to the compilers too late for inclusion in the main body of this bibliography. They are therefore listed separately below:

78. ECKERTOVA, L. Fysika a pouziti katod emitujicich v silnem elektrickem poli. (Physics and applications of field cathodes). Cesk. Casopis Fys, A12, nos. 5-6, 561-72 (1962). Illus, 31 refs. [In Czech with English summary].

    This is a brief survey paper concerning cathodes; a section describes field emission in general terms.

79. GORBATYI, N.A. and GOFMAN, I.I. Ob izmerenii raboty vykhoda elektronov metodom elektrostaticheskoi emissii. (Measurement of the electron work function by field emission). Radiotekhn. i Elektron, 8, no.11, 1927-32 (1963). Illus, 10 refs. English translation: Radio Eng. Electron. Phys. USSR, 8, no.11. (To appear in 1964).

    The slopes of the Fowler-Nordheim plots, in conjunction with the Drechsler and Henkel method for establishing the voltage-field characteristics, were used to obtain an average work function for (110), (100), and (111) oriented tungsten tips. The values do not agree, and it is concluded that "average work function" measurements obtained from Fowler-Nordheim plots are not realistic.

80. MECLEWSKI, R., NIKLIBORC, J., and WOJDA, L. Field emission microscope investigation of iron migration. Acta Phys. Polon, 21, no.2, 189-91 (1962). Illus, 5 refs. [In English].

    The diffusion of iron was studied with a field emission microscope using an iron tip. The value of the activation energy obtained from the process in the presence of the electric field was $Q = 1.24 \pm 0.12$ ev.

81. MECLEWSKI, R. and WOJDA, L. Zastosowanie katod z latwo topliwych metali w polowym mikroskopie elektronowym. (Use of non-refractory cathodes in field emission microscopy). Zeszyty Nauk. Uniw. Wroclaw, Ser. B, 1959, no.3, 243. [In Polish].

    This paper was not available at the time of the publication of this bibliography.

82. ROBOZ, P. Studium adsorpce plynu v ultravysokem vakuu autoemisnim mikroskopem. (Study of adsorption of gases in ultra-high vacuum by a field-emission microscope). Cesk. Casopis Fys, A12, nos.5-6, 641-3 (1962). Illus. [In Czech with English summary].

A field emission microscope was used to determine pressures in high vacuum systems by measuring the time required for the formation of what was considered a monolayer.

83. SHREDNIK, V.N. K voprosu ob usrednenii avtoemissionnoi raboty vykhoda. (Calculation of the average work function in field emission). Radiotekhn. i Elektron, 8, no.11, 1933-44 (1963). 15 refs. English translation: Radio Eng. Electron. Phys. USSR, 8, no.11 (To appear in 1964).

The effect of patch fields on the form of the characteristics of ln $(I/V^2) = f(1/V)$ for an emitter is analyzed. Dispersion relations for the function $V\phi^{3/2}/E$ -- where V, ϕ and E are the voltage, work function and field -- are discussed.

84. SIDORSKI, Z. Desorpcja polowa strontu z wolframu. (Field desorption of strontium from tungsten). Ph.D. Dissertation, Wroclaw Univ, Poland. (In press). [In Polish.]

85. WOJDA, L. Badanie metoda emisji polowej zjawisk zachodzacych na powierzchni zelaza, grzanego w silnym polu elektrycznym. (Study of field emission phenomena occurring on the surface of iron heated in strong electric fields). Ph.D. Dissertation, Wroclaw Univ, Poland. (In press). [In Polish.]

3. LIST OF MEETINGS AND PAPERS RELEVANT TO SOVIET FIELD EMISSION RESEARCH

This Section lists meetings held in the period between March 1958 and March 1963 and papers read at these meetings which have a bearing on Soviet field emission research. Most of these meeting transactions and seminar reports are published in Radiotekhnika i Elektronika. The pertinent Russian papers and their English translations, with respective page references, are cited below each meeting.

Many of these papers, of course, are subsequently published in the Soviet technical literature; such instances are brought to the reader's attention by the phrase "for annotations, see entry #..." in Section 2.

3.1 INTER-INSTITUTIONAL SEMINAR ON CATHODE ELECTRONICS., 8th. MOSCOW, March 3, 1958. (MEZHDUVEDOMSTVENNYI SEMINAR PO KATODNOI ELEKTRONIKE, 8-e). KOFANOVA, T.I. Radiotekhn. i Elektron, 3, no.7, 973-5 (1958). English translation: Radio Eng. Electron. USSR, 3, no.7, 169-73 (1958).

3.11 GOFMAN, I.I. Issledovanie avtoelektronnoi emissii (AE) SiC s tsel'iu sravneniia eksperimental'nykh dannykh s teoriei, predlozhennoi Strettonom, pp.973-4. (Experimental investigation of field emission from SiC and comparison with the Stratton theory, pp. 170-1).

3.2 INTER-INSTITUTIONAL SEMINAR ON CATHODE ELECTRONICS, 14th. MOSCOW, March 2, 1959. (MEZHDUVEDOMSTVENNYI SEMINAR PO KATODNOI ELEKTRONIKE, 14-e). ALEKSEEVA, A.P. and others. Radiotekhn. i Elektron, 4, no.7, 1215-6 (1959). English translation: Radio Eng. Electron. USSR, 4, no.7, 231-5 (1959).

3.21 GOFMAN, I.I. and SHUPPE, G.N. Avtoelektronnaia emissiia s monokristalla vol'frama pri pomoshchi metodiki impul'snykh izmerenii, p. 1216. (Pulsed technique in the study of field emission fron tungsten single crystals, p. 234).

3.3 ALL-UNION CONFERENCE ON CATHODE ELECTRONICS, 9th. MOSCOW, October 21-28, 1959. (VSESOIUZNOE SOVESHCHANIE PO KATODNOI ELEKTRONIKE, 9-e). BASALAEVA, N.IA. and others. Radiotekhn. i Elektron, 5, no.5, 866-79 (1960). English translation: Radio Eng. Electron. USSR, 5, no. 5, 232-57 (1960).

3.31 ALPATOVA, N.M. Razrabotka metodiki elektrokhimicheskogo polucheniia avtoelektronnykh emitterov razlichnoi konfiguratsii iz germaniia, vol'frama i karbida tsirkoniia, p.875. (Development of electrochemical methods of obtaining field-emission emitters of various shapes from germanium, tungsten and zirconium carbide, p. 249). (For annotation, see entry #2).

3.32 ECKERTOVA, L.I. Vremennaia zavisimost' avtoelektronnogo toka s vol'framovogo ostriia, p. 875. (Time dependence of field emission currents from a tungsten point, p. 249).(For annotation, see entry #5).

3.33 ELINSON, M.I., GOR'KOV, V.A., IASNOPOL'SKAIA,A.A. and KUDINTSEVA, G.A. Issledovanie impul'snoi avtoelektronnoi emissii pri vysokikh plotnostiakh tokov, pp.874-5. (Investigation of pulsed field emission at high current densities,pp.248-9).(For annotation, see entry #9).

3.34 GOFMAN, I.I., PROTOPOPOV, O.D., and SHUPPE, G.N. Issledovanie avtoelektronnoi emissii s metalla v impul'snom rezhime, p.874.(Investigation of pulsed field emission from metals, p.248).(For annotation, see entry #19).

3.35 KOMAR, A.P., SAVCHENKO, V.P., and SHREDNIK, V.N. Adsorbtsiia, migratsiia i isparenie berilliia na monokristalle vol'frama, p.868.(Adsorption, migration and evaporation of beryllium on tungsten single crystals, p.236). (For annotation, see entry #31).

3.36 KOMAR, A.P., SAVCHENKO, V.P., and SHREDNIK, V.N. Novyi metod izgotovleniia avtoelektronnykh emitterov iz legkoplavkikh metallov i splavov,p.874). (New method of preparing field emitters of non-refractory metals and alloys, p.248). (For annotation, see entry #30).

3.37 KOMPANEETS, A.S. Vliianie ob"emnogo zariada na avtoelektronnuiu emissiiu, p. 874. (Influence of space charge on field emission, pp.247-8). (For annotation, see entry #35).

3.38 SHREDNIK, V.N. Zavisimost' raboty vykhoda plenochnykh katodov ot stepeni pokrytiia, p. 868. (Dependence of work function of film cathodes on the extent of coverage, p. 236). (For annotation, see entry #50).

3.39 SIROTENKO, I.G., SPIVAK, G.V., and GROMAN, A. Avtoelektronnaia emissiia nitevidnykh poluprovodnikovykh monokristallov, p.874. (Field emission from semiconductor whiskers, p.247). (For annotation, see entry #54).

3.40 ZUBENKO, IU.V. and SOKOL'SKAIA, I.L. Avtoelektronnaia emissiia s karbida i torirovannogo karbida vol'frama, p. 874. (Field emission from tungsten carbide and thoriated tungsten carbide, p. 247). (For annotation, see entry #74).

3.4 SYMPOSIUM ON FIELD EMISSION, 1st. TASHKEND, MAY 10 - 20, 1960. (PERVYI SIMPOZIUM PO AVTOELEKTRONNOI EMISSII). GOR'KOV, V.A. Radiotekhn. i Elektron, 5, no.12, 2069-73 (1960). English translation: Radio Eng. Electron. USSR, 5, no.12, 303-13 (1960).

3.41 ELINSON, M.I. and ZHDAN, A.G. Emissiia elektronov pod deistviem sil'nogo elektricheskogo polia iz katodov tsilindricheskoi formy na osnove SiO_2 + C, p.2073. (Field emission from cylindrical cathodes coated by SiO_2 + C, p.312). (For annotation, see entry #12).

3.42 ELINSON, M.I., ZHDAN, A.G., and VASIL'EV, G.F. Ob interpretatsii khoda vol'tampernykh kharakteristik avtoelektronnoi emissii poluprovodnikov i metallov, p. 2072. (Interpretation of the current-voltage characteristics of field emission from semiconductors, pp. 310-11). (For annotation, see entry #13).

3.43 GORBATYI, N.A. Vliianie temperatury ostriia ionnogo proektora na ionizatsiiu u poverkhnosti, pp.2071-2. (Effect of temperature of the field ion microscope tip on surface ionization, p.309).

3.44 KOMAR, A.P., SAVCHENKO, V.P., and SHREDNIK, V.N. Koeffitsienty poverkhnostnoi diffuzii berilliia na vol'frame, p.2070. (Coefficients of surface diffusion of beryllium on tungsten, p. 305).

3.45 KOMAR, A.P., TALANIN, IU.N. and CHERNIAVSKAIA, N.A. Vliianie raspredeleniia primesei na emissionnye kartiny platiny, p.2070. (Influence of impurity distribution on the emission patterns of platinum, p. 305).

3.46 KRYLOV, K.I.,BONCH-OSMOLOVSKII, A.I. and FEDOROV, V.L. Formirovanie elektronnogo potoka s avtoemissionnogo katoda s pomoshch'iu sil'nogo impul'snogo magnitnogo polia, p. 2071. (Formation of an electron flux from a field emission cathode by means of a strong pulsed magnetic field, p. 308).

3.47 KRYLOV, K.I. and FEDOROV, V.L.Katody AEE iz provoloki malogo diametra, p. 2069. (Field emission cathodes made of a small-diameter wire, p. 304).

3.48 PROTOPOPOV, O.D. and SMIRNOV, B.G. Vliianie kremniia i germaniia na elektronnuiu emissiiu s monokristalla vol'frama, p. 2073. (Effect of silicon and germanium on electron emission from tungsten single crystals, p. 313). (For annotation, see entry #45).

3.49 ROGINSKII, S.E. and SHISHKIN, V.A. Issledovanie slozhnykh molekuliarnykh kartin riada elementoorganicheskikh i organicheskikh soedinenii, p. 2072. (Study of complex molecular patterns of a number of organic-element and organic compounds, pp. 309-10).

3.50 SHISHKIN, V.A. Issledovanie emissionnykh izobrazhenii, voznikaiushchikh pri adsorbtsii dvukhatomnykh molekul i molekul inertnykh gazov, p. 2071. (Study of emission patterns obtained following adsorption of diatomic and inert-gas molecules, p. 309).

3.51 SHUPPE, G.N. Issledovanie po avtoelektronnoi emissii v SSSR, p. 2069. (Field emission research in the USSR, pp. 303-4).

3.52 SOKOL'SKAIA, I.L. Izuchenie adsorbtsii, migratsii i ispareniia kadmiia na vol'frame v elektronnom proektore, p. 2070. (Adsorption, migration and evaporation of cadmium on tungsten, p. 306). (For annotation, see entry #55).

3.53 SOKOL'SKAIA, I.L. and SHCHERBAKOV, G.P. Izuchenie effektov sil'nogo polia v emitterakh -- monokristallakh sernistogo kadmiia, p. 2071. (Effect of strong fields in CdS single crystal emitters, pp. 307-8). (For annotation, see entry #63).

3.54 VASIL'EV, G.F. Vliianie formy poverkhnostnogo potentsial'nogo bar'era i raspredeleniia polia po poverkhnosti emittera na vid vol't-ampernykh kharakteristik AEE, pp. 2072 - 3. (Influence of the surface potential barrier shape and of field distribution near the emitter surface on FE current-voltage characteristics, pp. 311-2). (For annotation, see entry #66).

3.55 VASIL'KOVSKII, D.N. K voprosu ob ustoichivosti granei i vychislenii poverkhnostnoi energii kristalla, p. 2072. (Stability of crystal planes and calculation of the surface energy of crystals, p. 310).

3.56 ZUBENKO, IU.V. Adsorbtsiia, migratsiia i isparenie bariia na karbidirovannom vol'frame W_2C, p. 2070. (Adsorption, migration and evaporation of barium on carbide tungsten W_2C, p.306). (For annotation, see entry #71).

3.57 ZUBENKO, IU.V. Izuchenie formy monokristallicheskikh emitterov iz karbida vol'frama v elektronnom mikroskope, p. 2071.(Electron microscope study of the shape of tungsten carbide emitters, p. 307). (For annotation, see entry # 72).

3.58 ZUBENKO, IU.V. and KLIMIN, A.I. Povedenie Si i Ge na poverkhnosti vol'frama, p. 2073.(Behavior of Si and Ge on tungsten surfaces, p. 313).

3.5 ALL-UNION CONFERENCE ON CATHODE ELECTRONICS, 10th. TASHKEND, November 23 - 30, 1961.(KONFERENTSIIA PO KATODNOI ELEKTRONIKE,10-e). BALASHOVA, A.P. and others. Radiotekhn. i Elektron, 7, no.7, 1258-72 (1962). English translation: Radio Eng. Electron.Phys. USSR, 7, no.7, 1181-97 (1962).

3.501 ELINSON, M.I. and KUDINTSEVA, G.A. Avtoemissionnye katody i ikh svoistva , p. 1265. (Field-emission cathodes and their properties, p. 1189). (For annotation, see entry #10).

3.502 GOFMAN, I.I. Issledovanie elektrostaticheskoi elektronnoi emissii iz vol'frama v oblasti slabykh polei, p. 1265. (Study of field emission from tungsten in weak fields, p. 1189). (For annotation, see entry #18).

3.503 GOR'KOV, V.A., ELINSON, M.I. and IAKOVLEVA, G.D. Teoreticheskie i eksperimental'nye issledovaniia preddugovykh iavlenii pri avtoelektronnoi emissii, p. 1265. (Theoretical and experimental investigations of pre-arc phenomena in field emission, p. 1189. (For annotation, see entry #21).

3.504 GOR'KOV, V.A., ELINSON, M.I., and SANDOMIRSKII, V.B. Rol' prostranstvennogo zariada pri otbore predel'no vysokikh plotnostei toka, p.1265. (Role of space charge in obtaining critically high current densities, p. 1189). (For annotation, see entry #22).

3.505 SOKOL'SKAIA, I.L. and FURSEI, G.N. Izuchenie osobennostei avtoelektronnoi emissii v oblasti sil'nykh polei i bol'shikh plotnostei tokov, p. 1264. (Characteristics of field emission in the strong field and high current density range, p. 1188). (For annotation, see entry #58).

3.506 SOKOL'SKAIA, I.L. and MILESHKINA, N.V. Avtoelektronnaia emissiia s tonkikh sloev germaniia na vol'frame, p.1263. (Field emission from thin layers of germanium on tungsten, p. 1187). (For annotátion, see entry #62).

3.507 SOKOL'SKAIA, I.L. and SHCHERBAKOV, G.P. Eksperimental'naia proverka prichin nelineinosti vol't-ampernykh kharakteristik avtoelektronnoi emissii s monokristallov sernistogo kadmiia, pp. 1263-4. (Experimental investigation of the causes of nonlinearity of.the current voltage characteristics of field emission from cadmium sulfide single crystals, p. 1187). (For annotation, see entry #64).

3.508 SOKOL'SKAIA, I.L. and SHCHERBAKOV, G.P. Energeticheskoe raspredelenie avtoelektronov s monokristallov sernistogo kadmiia, p.1264. (Energy distribution of field emission electrons from cadmium sulfide single crystals, p. 1187).

3.509 VOROB'EV, A.A. and VOROB'EV, G.A. Otsenka avtoelektronnoi emissii v shchelochno-galoidnykh kristallakh, p. 1265. (Evaluation of field emission from alkali-halide crystals, p. 1189).

3.510 ZHDAN, A.G., SANDOMIRSKII, V.B. and ELINSON, M.I. Eksperimental'noe i teoreticheskoe issledovaniia spektrov emittirovannykh avtoelektronov iz poluprovodnikov, p. 1264. (Experimental and theoretical investigation of field emission spectra of semiconductors, p. 1188).

3.511 ZUBENKO, IU.V. and SOKOL'SKAIA, I.L. Avtoelektronnaia emissiia zoloto-barievykh sloev, p. 1263. (Field emission of gold-barium layers, p. 1187). (For annotation, see entry #77).

3.6 INTER-INSTITUTIONAL SEMINAR ON PHYSICAL FUNDAMENTALS OF CATHODE ELECTRONICS, 20th. MOSCOW, June 4 - 5, 1962.(MEZHDUVEDOMSTVENNYI SEMINAR PO FIZICHESKIM OSNOVAM KATODNOI ELEKTRONIKI, 20-e). BALASHOVA, A.P. and others. Radiotekhn. i Elektron, 7, no.10, 1846-8 (1962). English translation: Radio Eng. Electron. Phys. USSR, 7, no.10, 1711-3 (1962).

3.61 FURSEI, G.N. and TOLKACHEVA, I.D. Issledovanie effektov,predshestvuiushchikh vakuumnomu proboiu, dlia avtoelektronnykh emitterov iz Ta i Mo,p.1846. (Pre-breakdown effects in field emission from Ta and Mo, p. 1711). (For annotation, see entry#16).

3.62 GOFMAN, I.I. and GORBATYI, N.A. Issledovanie vol't-ampernykh kharakteristik avtoelektronnogo toka s razlichno orientirovannykh vol'framovykh ostrii, p. 1847. (Field emission currents from variously oriented tungsten tips, p. 1712).

3.63 NOVIKOV, B.V., SOKOL'SKAIA, I.L.,and SHCHERBAKOV, G.P. Issledovanie zavisimosti avtoelektronnoi emissii s monokristallov CdS ot dliny volny padaiushchego sveta pri 85 °K, p.1846. (Investigation of field emission from CdS single crystals as a function of the wavelength of incident light at 85°K, p. 1711).(For annotation, see entry #44).

3.64 SOKOL'SKAIA, I.L. Temperaturnaia zavisimost' avtoelektronnogo toka s monokristallov CdS, p. 1846. (Temperature dependence of field emission currents from CdS single crystals, p. 1711).(For annotation, see entry #57).

3.65 ZUBENKO, IU.V. Issledovanie pri pomoshchi elektronnogo proektora avtoelektronnoi emissii sloev Ti na W i W_2C, p. 1846. (Field-emission microscope study of Ti layers on W and W_2C, p. 1711).

3.7 INTER-INSTITUTIONAL SEMINAR ON PHYSICAL FUNDAMENTALS OF CATHODE ELECTRONICS, 21st. MOSCOW, November 12 - 14, 1962. (MEZHDUVEDOMSTVENNYI SEMINAR PO FIZICHESKIM OSNOVAM KATODNOI ELEKTRONIKI, 21-e). ZHDAN, A.G. Radiotekhn. i Elektron, 8, no.6,1088-94 (1963). English translation: Radio Eng. Electron. Phys. USSR, 8, no.6; (expected to appear early 1964).

3.71 FURSEI, G.N. Impul'snaia avtoelektronnaia emissiia s reniia, p. 1089. (Pulsed field emission from rhenium).

3.72 GASS, V.F. Nekotorye voprosy raboty avtokatoda v SVCH-pole, p. 1089. (Performance of field emission cathodes in microwave fields).

3.73 SANDOMIRSKII, V.B. and KOGAN, SH.M. Vliianie kvantuiushchego magnitnogo polia na avtoelektronnuiu emissiiu, p. 1088. (Effect of quantizing magnetic fields on field emission).

3.74 SHREDNIK, V.N. K voprosu ob usrednenii avtoemissionnoi raboty vykhoda, p. 1088. (Determination of average work function values by means of field emission). (For annotation, see entry #83).

3.8 INTER-INSTITUTIONAL SEMINAR ON PHYSICAL FUNDAMENTALS OF CATHODE ELECTRONICS, 22nd. MOSCOW, March 11 - 12, 1963. (MEZHDUVEDOMSTVENNYI SEMINAR PO FIZICHESKIM OSNOVAM KATODNOI ELEKTRONIKI, 22-e). ZHDAN, A.G. Radiotekhn. i Elektron, 8, no.8, 1491-5(1963) English translation: Radio Eng. Electron.Phys. USSR, 8, no.8;(expected to appear early 1964).

3.81 KOMAR, A.P. and SAVCHENKO, V.P. Avtoelektronnaia emissiia metallopodobnykh molekul i polimerov C, Se, Te i Bi, p. 1491. (Field emission of metal-like molecules and polymers of C, Se, Sb, Te and Bi).

3.82 KOMAR, A.P. and SIUTKIN, N.N. Avtoelektronnaia emissiia stareiushchego splava Ni-Be, p. 1491.(Field emission from aging Ni-Be alloys).

3.83 SHREDNIK, V.N. and TASKAEVAIA, E.V.Avtoelektronnaia emissiia natriia na vol'frame, p. 1491.(Field emission from sodium on tungsten).

3.84 SOKOL'SKAIA, I.L. Energeticheskoe raspredelenie elektronov pri avtoelektronnoi emissii so sloev germaniia na vol'frame, p. 1492. (Energy distribution of field-emitted electrons from germanium on tungsten).

3.85 ZUBENKO, IU.V. Avtoelektronnaia emissiia reniia, pokrytogo toriem, p. 1492. (Field emission from rhenium coated with thorium).

4. REFERENCES

The following indexing and abstracting journals (dates of issues searched are indicated) proved to be very useful in locating relevant papers in the original and translated Soviet technical literature on field emission research:

Annotirovannyi Ukazatel' Literatury po Radioelektronike. (Annotated Bibliography of Electronics). Moscow, Sovietskoe Radio, 1960 - 2. [In Russian].

Chemical Abstracts. Washington, American Chemical Society 1960 - to date.

Chemical Titles. Washington, American Chemical Society, 1960 - to date.

Current Contents of Space, Electronic and Physical Sciences. Philadelphia, Institute for Scientific Information, 1961 - to date.

East European Accessions Index. Washington, U.S. Government Printing Office, 1960 - 1961. [Ceased publication].

Monthly Index of Russian Accessions. Washington, U.S. Government Printing Office, 1960 - to date.

Nuclear Science Abstracts. Oak Ridge, Tenn. U.S. Atomic Energy Commission, 1960 - to date.

Physics Abstracts. London, Institution of Electrical Engineers, 1960 - to date.

Physikalische Berichte. Braunschweig, Verband Deutscher Physikalischer Gesellschaften, 1960 - to date. [In German].

Referativnyi Zhurnal: Fizika. (Abstract Journal: Physics). Moscow, VINITI, 1960 - to date. [In Russian].

Referativnyi Zhurnal: Khimiia. (Abstract Journal: Chemistry). Moscow, VINITI, 1960 - to date. [In Russian].

Technical Translations. Washington, U.S. Department of Commerce, Office of Technical Services, 1960 - to date.

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