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NOTE ON THE SPECTRAL REFLECTIVITY OF RHODIUM

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ABSTRACT

The spectral reflectivity of rhodium in the ultraviolet and in the visible spectrum is described. The samples examined consisted of mirrors of rhodium deposited electrolytically on plate glass and upon a highly polished surface of copper. The reflectivity of rhodium decreases rapidly with wave length, to a low value in the ultraviolet. In the visible spectrum the reflectivity is somewhat higher than for chromium, and hence rhodium is more efficient as a reflecting surface.

Because of the relatively high reflecting power of rhodium for visible radiation and its resistance to tarnish, electroplated surfaces of this metal have in recent years come into commercial use in plating jewelry and as mirrors for searchlights, headlights, etc.

The object of this note is to supply the demand for information on the spectral reflectivity, particularly in the ultraviolet, of recent productions of highly polished surfaces of rhodium, prepared on a commercial scale, by electrolytic deposition on polished glass, copper, or other suitable material.

To complete the description of the reflectivity of rhodium from the extreme ultraviolet into the far infrared, reference is made to a previous paper [1] [1] on the infrared reflecting power of a highly polished surface on an ingot of rhodium prepared by von Wartenberg [2]. It was found that the reflecting power increases rapidly from about 77 percent in the yellow (579 mμ) to 92 percent at 2,500 mμ (curve 3, fig. 1), beyond which point the reflectivity increases gradually to about 94 percent at 9,000 mμ [1]. The reflectivity (77 percent) in the visible spectrum is in good agreement with the measurements on the best sample of the herein described electroplated deposits. The much lower ultraviolet reflectivity values obtained in 1930 on another ingot of rhodium [6] are to be ascribed to the condition of the surface of that sample, which contained blowholes and was not so highly polished.

It is to be noted that the reflectivity in the ultraviolet is easily affected by the method of preparation of the mirror (cathode sputtering, etc.) and by the kind of polishing material used. The present contribution therefore reveals the performance that may be expected of present-day commercially prepared rhodium mirrors.

The apparatus used in making the herein described spectral-reflectivity measurements in the ultraviolet, visible, and near infrared spectrum consisted of a quartz-fluorite achromatic lens spectrometer [5] and a vacuum thermopile. The source of radiation was a vertical quartz-mercury-vapor (Uviarc) lamp. By means of a quartz-fluorite lens an image of the luminous column of mercury vapor was

[1] Numbers in brackets indicate the literature references at the end of this paper.

focused upon the entrance slit of the spectroradiometer, and the spectral intensities were measured, after reflection from (a) the hypotenuse face of a right-angled quartz prism and (b) after reflection from the mirror (in this case, rhodium) under investigation. During the latter measurement a thick quartz plate was placed before the spectrometer slit to compensate for the reflection losses at the surfaces and the change in optical path when the rays pass through the quartz

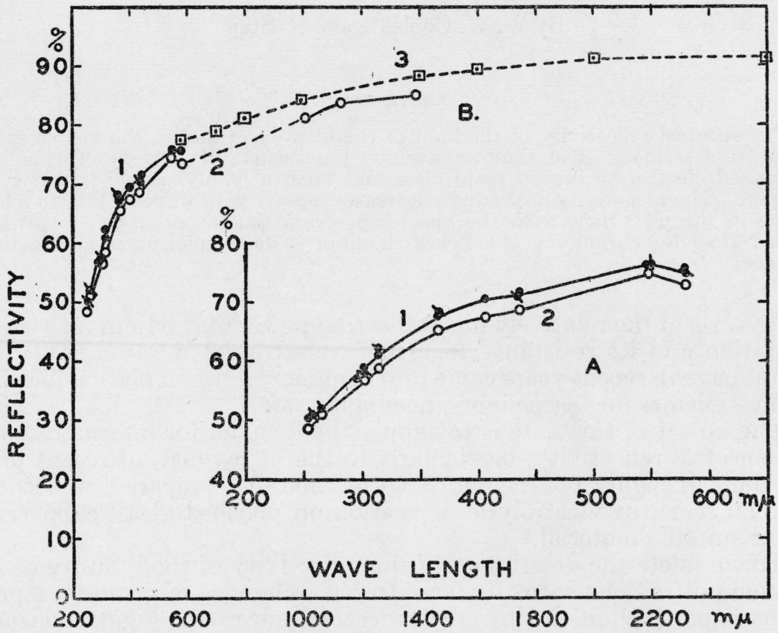

FIGURE 1.—*Reflectivity of rhodium*

Curve 1, electrolytic deposit on glass; curve 2, electrolytic deposit on polished copper; and curve 3, mirror surface, polished on an ingot of rhodium.

prism [3, 4]. In this manner the reflectivity data are obtained without making any corrections.

Two of the mirrors of rhodium included in this report were prepared by electrolytic deposition on plate glass. Whether the first conducting coating on the glass was copper or silver was not disclosed by the manufacturer (name not disclosed). These samples, which were submitted by the Electrical Testing Laboratories, were entirely opaque, except for a few small-sized holes. As shown in figure 1, curve 1, there is no appreciable difference in their ultraviolet spectral reflectivity.

Several mirrors were available in which the rhodium was deposited electrolytically upon a thick, flat plate of optically polished copper. They were made by the Bart Laboratories, Inc., Belleville, N. J. The sample (size about 5 by 5 cm) selected for measurement was deposited from a solution taken from a large tank used in the factory for plating large mirrors.

Although the rhodium mirror that was deposited electrolytically on copper appeared to have a finer surface, as shown in figure 1, curve 2, the spectral reflectivity is a few percent lower than that of the samples deposited on glass.

In both kinds of mirrors (deposited on glass and on metal) the spectral reflectivity of rhodium decreases rapidly with wave length in the ultraviolet and is so much lower than that of chromium and aluminum that it is not a promising source of material for mirrors for reflecting ultraviolet radiation [4]. Because of its high reflecting power in the visible and near infrared, as shown in figure 1, rhodium is more suitable than chromium (previously described [4]), as a material for reflectors of visible radiation.

Repeated measurements on these mirrors showed a slightly lower reflectivity at 579 mμ than at 547 mμ (see fig. 1), followed by a much higher reflectivity beyond 1014 mμ in the infrared. Apparently, there is a slight flattening of the reflectivity curve in the region of 600 to 700 mμ, similar to the low reflectivity observed in chromium [4]; but confined to a much narrower spectral band, as observed in tungsten [3], which has a narrow minimum of reflection at about 800 mμ.

In conclusion, it is to be emphasized that in the present state of development, electroplated mirrors of rhodium are found to differ appreciably from sample to sample in the total amount of light reflected. However, there appears to be a similarity in the general trend of their spectral reflectivity. The possibility of electroplating or evaporating rhodium on astronomical mirrors is foreshadowed.

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[3] W. W. Coblentz and W. B. Emerson, BS Sci. Pap. **14,** 307 (1918) S308.
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