TRANSMISSION AND REFLECTION OF GOLD AND SILVER FILMS

By W. V. Houston* and George Moore

To select the most efficient coatings for the mirrors of interferometers, it is necessary to know the reflecting power and the transmission of thin metallic films as a function of the wavelength and the thickness. This paper describes some rough measurements made on gold and silver films.

The films were deposited on an interferometer plate by cathode sputtering. The measurements were made with a Nutting spectrophotometer made by A. Hilger, and extended between 4600A and 7000A. This range is sufficient to show the regions of superiority of gold and silver. The transmission measurements were made directly on the spectrophotometer. The reflection measurements were made by reflecting the image of the pointolite source into one aperture of the photometer, and allowing the direct light from the lamp to fall on the other. A correction was then made for the different distances through which the light had traveled. To take account of any difference in emission from the lamp, it was reversed and the geometrical mean of the readings was taken as correct. No great precision was attained, but the measurements do show the order of magnitude of the quantities involved, and should be correct within 10%. It is expected, in future work, to extend the range and precision of this work on these and other metals.

The variation with wavelength, for intermediate reflecting powers, was found to be essentially independent of the thickness, and hence can be represented by a single set of values. Table 1 gives the reflection and transmission for various wavelengths in terms of that at 6000A. These values are the averages of those from four plates of different thicknesses. This table shows clearly the maximum of transmission which gives gold its green color by transmitted light.

Table 2 shows the reflecting power and the transmission at 6000A of the plates studied. The sum of the reflection and transmission is considerably less than 100%. The difference is due to the absorption

* National Research Fellow in Physics.

TABLE 1. *Variation with wave length.*

Wave length	Silver		Gold	
	Refl.	Trans.	Refl.	Trans.
7000	1.17	.88	1.29	.80
6800	1.16	.88	1.23	.63
6600	1.09	.87	1.27	.77
6400	1.07	.93	1.14	.87
6200	1.02	.97	1.09	.89
6000	1.00	1.00	1.00	1.00
5800	.97	1.14	.94	1.04
5600	.97	1.21	.83	1.14
5400	.92	1.33	.75	1.25
5200	.86	1.40	.62	1.32
5000	.84	1.46	.55	1.35
4800	.79	1.82	.45	1.16
4600	.72	2.14	.55	.95

in the glass and the metal film, and the reflection from the glass face when the transmission is measured. The variation in the sum, however, represents the variation in the absorption of the metal, since the other

TABLE 2. *Reflection and transmission at 6000A.*

	Silver				Gold			
Refl.	25.8	69.5	80.8	81.0	38.0	49.6	61.7	81.0
Trans.	34.7	2.8	.8	2.0	39.0	27.1	14.7	2.5
Sum	60.5	72.3	81.6	83.0	77.0	76.7	76.4	83.5

quantities are almost constant. The sum for the silver films is somewhat less than that given by Fabry and Buisson[1], but the transmission of the uncoated glass ranged around 80%, and this probably explains the difference.

For use with the Fabry-Perot interferometer we have the equation for the intensity of the maximum[1]

$$I_{max} = t/(1-r)$$

where t is the transmission and r is the reflection. For the resolving power of the simple interferometer we have[2]

$$\lambda/\Delta\lambda = \pi n r^{1/2}/(1-r),$$

[1] Fabry and Buisson, Journal de Physique, *8*, p. 190; 1919.
[2] Houston, Phys. Rev., *29*, p. 478; 1927.

and for the compound interferometer,

$$\lambda/\Delta\lambda = \pi n r^{1/2}(1+R^2)^{1/2}/(1-r)$$

where n is the order of interference and R is the ratio between the interferometers. Thus the intensity depends upon t, while a high resolving power requires a large value of r.

From this point of view the gold film is seen to be superior around 6000A, since for the same reflecting power there is considerably greater transmission. From Table 1 it can be seen that the gold is increasingly superior toward higher wavelengths. Between 5000 and 6000A gold and silver are about equally good, but below 5000A the reflecting power of the gold drops so low that the silver is much superior to it.

These observations confirm the experience of workers with interferometers who use gold films for the red and infrared regions in preference to the silver.

NORMAN BRIDGE LABORATORY,
CALIFORNIA INSTITUTE OF TECHNOLOGY,
PASADENA, CALIFORNIA,
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An Introduction to Clinical Perimetry. By H. M. Traquair, M. D., F.R.C.S., Ed. Assistant Ophthalmic Surgeon, Royal Infirmary, Edinburgh, Etc. viii+264 pages, with 164 illustrations and a colored plate. C. V. Mosby Company, St. Louis, 1927.

Perimetry consists in the technique of examining the field of vision, together with the science of interpreting the data so obtained. The complexities of the anatomy of the retina and optic pathways are such that injuries at different points produce characteristically different defects in the visual fields. The prime importance of perimetry is, therefore, in relation to the diagnosis of diseases of the eye, and the localization of lesions of the brain, particularly of brain tumors. While the practice of perimetry is more than fifty years old, modern quantitative methods have been used for only the past ten or fifteen years. The present book is a thorough and authoritative treatise on the subject, the most complete that has appeared in English.

The author, after discussing the various methods of examination, incidentally presenting most modestly his own important contributions to this field, reviews in detail the anatomy of the retina, optic nerve and visual pathways, illustrating with numerous figures and charts the characteristic defects produced by lesions at various points. A bibliography of the most important sources is added. The book should be of great value to ophthalmologists and neurologists.

JONAS S. FRIEDENWALD