LETTERS TO THE EDITORS

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Moiré Patterns in Transmission Electron Micrographs of Sub-Boundaries of Aluminium

MOIRÉ patterns are interference fringes observed through two superposed, slightly misoriented diffraction gratings, or through two parallel gratings of slightly different spacing. When the misorientation between the gratings is very small the spacing of the moiré fringes may be much greater than the grating spacing. Mitsuishi, Nagasaki and Uyeda¹ observed that the lattice in thin sheets of crystal may act as gratings to produce moiré patterns in the electron microscope. More recently, Hashimoto and Uyeda² have shown that dislocations in these crystals are revealed as dislocations in the moiré patterns, and Pashley, Menter and Bassett³ have recorded moiré patterns in specimens consisting of one metal epitaxially evaporated on to a single crystal film of another metal.

Hirsch⁴ has shown that it is possible to observe individual dislocations directly in thin metal films by transmission electron microscopy. This technique is being used in this Laboratory⁵ for studying specimens which include aluminium films beaten to a thickness of 2.5μ , annealed *in vacuo* at 350°C . and etched down to less than 1000 Å. in 1 per cent hydrofluoric acid in water. These thin films are examined in transmission in an experimental prototype Metropolitan-Vickers E.M.6 operating at 70 kV. and at a magnification of 30,000.

In some of these films quite extensive areas of sub-boundaries may be seen and, as the misorientation is small at such boundaries, the conditions should be suitable for the formation of moiré fringes.

Fig. 1. Moiré fringes on a sub-boundary in aluminium. ($\times 150,000$)

Such interference patterns have now been observed and an example is shown in Fig. 1. There is a much coarser extinction contour pattern in the same area. Individual dislocations are visible quite close to the boundary.

No dislocations have been found in the moiré patterns, though the dislocations which constitute the sub-boundaries are sometimes seen together with the moiré pattern. It appears, therefore, that the dislocations which form the sub-boundaries do not give rise to dislocations in the moiré pattern.

It is important to be able to assess the contribution of moiré patterns to electron micrographs of thin metal films studied in transmission. It also seems that useful information about the nature of sub-boundaries may be obtained by a study of moiré patterns, and further work is in progress on this aspect of the study of thin metal films.

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¹ Mitsuishi, T., Nagasaki, H., and Uyeda, R., *Proc. Jap. Acad.*, **27**, 86 (1951).

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⁴ Hirsch, P. B., Horne, R. W., and Whelan, M. J., *Phil. Mag.*, **1**, 677 (1956).

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Oxide Films on Silver at High Temperatures

It is usually assumed that no oxide film can exist on the surface of metallic silver heated in air above 200°C ., since bulk silver oxide, when heated in air, decomposes completely into silver and oxygen at this temperature¹. Recent work in this laboratory has shown that this is not the case.

It is well known that mercury readily wets clean film-free solid metals but does not wet non-metallic surfaces—a fact demonstrated by Hoar and Farthing² during the electro-polishing of α -brass. This experiment has now been repeated for silver heated at various temperatures up to 800°C .

Two specimens, each 5 cm. $\times$ 1.8 cm. $\times$ 0.2 mm., of oxygen-free 99.99 per cent silver with a mirror finish were heated *in vacuo* to 450°C ., and at this temperature hydrogen was introduced into the system for two periods of ten minutes, with an intervening evacuation. This was done in order to remove any initial film on the surface of the specimen. After the second hydrogen treatment, the system was again evacuated and the temperature raised to 800°C . Pure oxygen was then introduced at a