Preparation of Aluminium of Extreme Purity by the 'Zone Fusion' Process

THE special properties of aluminium refined by double electrolysis and of conventional purity 99·99–99·998 per cent are well known. We have considered the application to this material of the 'zone fusion' process, which permits the production of germanium of extreme purity[1]. In our experiments we have employed a bar of such refined aluminium about 40 cm. long and 4 cm.^{2} in cross-section. This bar was placed in a boat of pure alumina and a length of 6–8 cm. raised to the melting point in a high-frequency furnace, the zone of fusion being traversed through the furnace at the rate of 5 mm. an hour.

In our first experiments notable purification of the 99·998 per cent metal after three such treatments was obtained[2]. After cold work, such material recrystallizes in large grains at a temperature of – 20° C.

After nine such fusion processes, the analyses being carried out with the aid of radioactive elements[3], we are led to believe that the conventional purity clearly exceeds 99·999 and is probably very near 99·9995.

By the classical strain-anneal technique we have prepared this aluminium in the form of single crystals. For this the ingot was rolled at a temperature near that of liquid nitrogen, since this metal recrystallizes at – 50° C., after which it was subjected to the usual treatment.

Measurement of the resistivities in liquid hydrogen and liquid helium[4] shows very considerable differences as compared with the refined aluminium of 99·99 and 99·998 per cent.

Fig. 1 shows the very important differences in the ratio $R_0/R_{20\cdot4^\circ\text{K}.}$ (the ratio of the resistivity at ordinary temperatures to that at the low temperature) for aluminium purified by three treatments (curve 3) and nine zone fusions (curve 4).

It was important to know what proportion of the metal had been purified after nine treatments; that is, what length of the bar consisted of metal of the highest purity. In Fig. 2 we have plotted the distances from the head of the bar as abscissæ and the ratio $R_0/R_{20\cdot4^\circ\text{K}.}$ as ordinates. This shows that the first 30 cm. of the bar, of total length 45 cm., consist of this highly purified material.

Such experiments demonstrate the interest which this method has for ordinary metals. The extreme degree of purity leads to new properties in many different fields, among which we are at present studying, in the laboratory at Vitry, problems of recrystallization, polygonization[5], electrical conductivity, corrosion and grain boundary fusion[3-6].

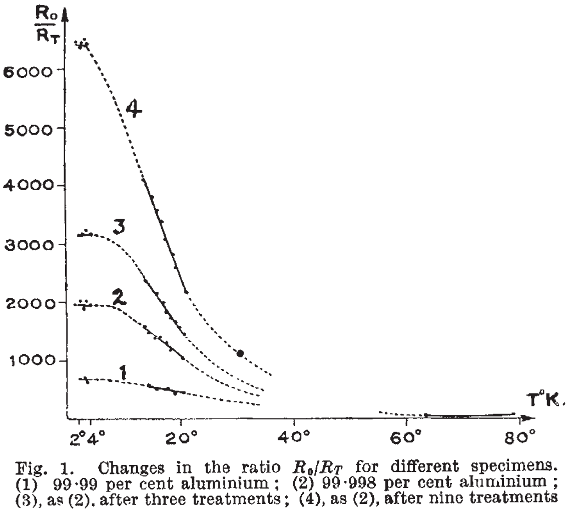

Fig. 1. Changes in the ratio R_0/R_T for different specimens. (1) 99·99 per cent aluminium; (2) 99·998 per cent aluminium; (3), as (2), after three treatments; (4), as (2), after nine treatments

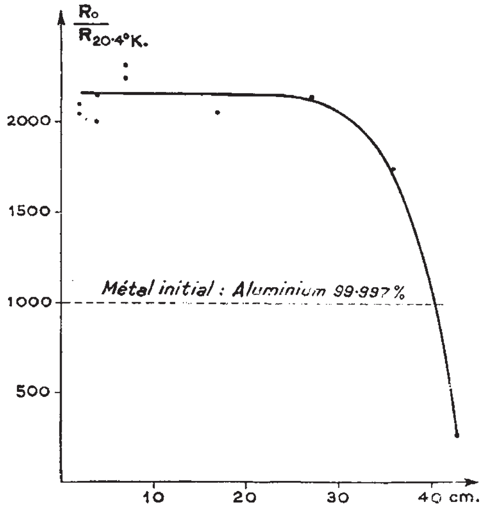

Fig. 2. Purification of 99·997 per cent aluminium after nine treatments. Note that the first 30 cm. of the bar consists of highly purified metal

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[1] Pfann, W. G., *J. Metals*, 4, 747 and 861 (1952).

[2] Chaudron, G., Conférence à Nancy le 26 novembre 1953, *Bull. Soc. Chim. France*, 419 (1954). Montariol, F., Reich, R., Albert, P. and Chaudron, G., *C. R. Acad. Sci., Paris*, 238, 815 (1954).

[3] Albert, P., Caron, M., and Chaudron, G., *C.R. Acad. Sci., Paris*, 233, 1108 (1951).

[4] Caron, M., Albert, P., and Chaudron, G., *C.R. Acad. Sci., Paris*, 238, 686 (1954).

[5] de Beaulieu, C., Talbot, J., and Chaudron, G., *C.R. Acad. Sci., Paris*, (July 5, 1954).

[6] Montariol, F., Albert, P., and Chaudron, G., *Rev. Métallurg.*, 50, 768 (1953).

Photoelastic Effects in Microscopic Fibres

THE application of fairly high pressures to fibre specimens on the microscope has been found to produce types of photoelastic stress patterns in cotton and nylon fibres. The method, which is modified from the original technique devised by Boddy[1] and that due to Merton[2], consists in applying a load to a lever system which exerts pressure on the condenser. The front lens of this is replaced with a sapphire sphere $\frac{1}{16}$ in. or $\frac{1}{8}$ in. in diameter. This operates through the cover slip on the specimen. Thus light rays can be focused through the sphere and through the material while pressure is applied or released, and the behaviour of the fibres watched throughout the process.

The interferometric slides and cover-slip of semi-metallized glass due to Merton give rise to optical path differences by reflexion, and the stress fringes in the materials may be observed without using polarizers.

Fig. 1 shows them in a cotton fibre after the pressure has been removed, and it is interesting to note that they remain in this material for some considerable time. A similar fringe system can be produced in a