over the cellular region detected no impurity at the 0.1 % level.

3. Etching of Sapphire

In addition to the above crystallisation effects the etching of sapphire by Al vapour previously reported by Carnahan, Johnson and Li [7] has been further investigated. Many of the ruby and sapphire plaques used in experiments above 1200° C showed a mass of etch pits on their upper surface (see fig. 3). The intensity of the etching was much greater outside the region covered by the reaction rings, and often brought into prominence (at higher magnification) numerous polishing scratches. The area that had at one time been covered by molten aluminium had a more chemically polished appearance and far fewer etch pits. Outside the reaction rings the etching became less intense with distance from the aluminium and no attack was detected on the underside of the plaques. From examination of numerous sessile-drop specimens, and from subsidiary experiments designed specifically to test the hypothesis [10], it has been established that the attack is more severe on those plaques oriented with the *c*-axis at 90° to the surface than those oriented at 0°. On occasion plaques with the former orientation showed well-defined hexagonal etch pits. The above observations are in general accord with previous results on the action of other chemical polishes and etchants on corundum [11].

4. Summary

In summary it appears that a rather complex situation exists in the Al–Al_2O_3 system represented by a sessile drop resting on a plaque in a vacuum. Both attack of the Al_2O_3 by Al, in either the liquid or the vapour state, and regrowth of α–Al_2O_3 at the aluminium-sapphire and aluminium-vapour interfaces are possible, depending on time and temperature.

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Letters

Influence of Structure on the Conductivity of Thin Films of Bismuth

The conductivity of thermally grown films of bismuth show very erratic behaviour with thickness [1, 2] below 3 μm. Explanations of this effect have involved the orientation of the crystallites [3], scattering at grain boundaries [1] and a size effect [4] due to the long mean free path of electrons in bismuth. Neuman [1] tried to relate this unusual behaviour to the structure of the films, using electron microscopy; however, two-dimensional pictures do not reveal the peculiar growth of the films reported here.

We prepared several thin films of bismuth by thermal evaporation in a vacuum of 10^{-5} torr on glass substrates at 20° C and have varied the evaporation rates. The films were studied using scanning electron microscopy. Figs. 1 and 2 clearly show the unusual growth pattern of the film and it is apparent that a continuous film does not exist until the thickness exceeds about 6 μm, as determined from the photographs. The above workers found discontinuous resistance variation around 3 μm thickness, but considering that this result was determined by weighing, their film thickness should be considerably less than ours. Experiments are now being undertaken to observe structural changes

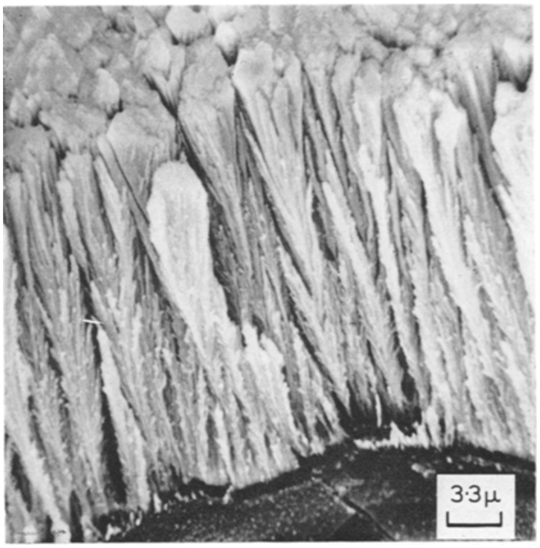

Figure 1 End-on view of bismuth film evaporated at 1000 Å per sec.

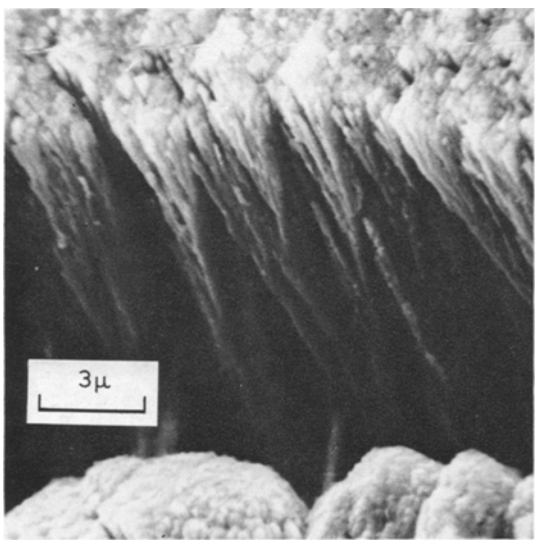

Figure 2 End-on view of bismuth film evaporated at 100 Å per sec.

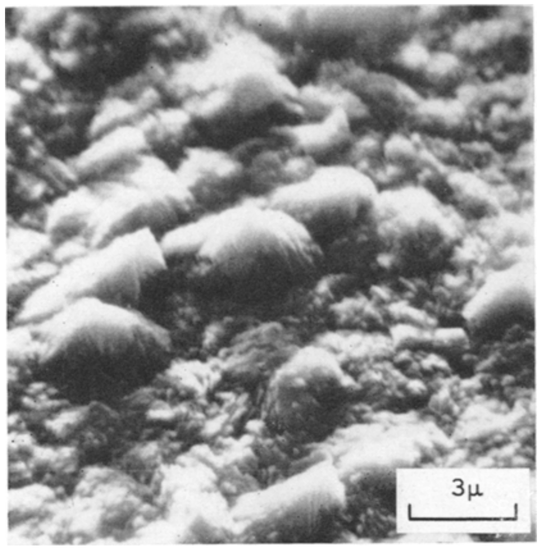

Figure 3 Top view of film as in fig. 1.

of films regrown from the liquid phase and films evaporated onto hot substrates.

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M. E. ERTL
P. MARCHANT
H. L. JOHNSON
School of Applied Sciences
University of Sussex,
Brighton