material in air at 750°C for 48 h produced well-crystallized γ-Al_2O_3 with an average particle size of 68 Å. Using this size, a density of 3.7 g cm^{-3} for γ-Al_2O_3, and assuming a spherical shape, the calculated minimum surface area would be 240 m^2 g^{-1}. As indicated by the X-ray data, "as-grown" particles are substantially smaller than 68 Å and certainly would not be spherical so that a surface area in the order of 1500 m^2 g^{-1} as required by Bruce and West is not unrealistic. (Even spherical particles in the order of 10 to 15 Å would yield such a surface area.)

As reported in our more recent paper [3], rehydration of well-crystallized, 68 Å γ-alumina to Boehmite was accomplished by boiling in water for 3 h. This was verified by both X-ray diffraction and DTA results. Thus, the results of Bruce and West that the "air-grown" product was converted to Bayerite by cold water immersion for 2 weeks or to Boehmite by boiling water immersion for 5 min are not at all verification that the starting material must be a hydroxide.

Finally, we did not find very precise heating conditions to be required to convert the "air-grown" Al/Hg reaction product to well-crystallized γ-Al_2O_3 [2]. In fact, almost any temperature between 600 and 900°C for some period of time should accomplish this. Additionally, both Bayerite and Boehmite were readily converted to γ-Al_2O_3 (verified by X-ray diffraction) [3] by heating at 10°C min^{-1} to 550°C in a DTA apparatus. Thus, the ability to convert or ease of conversion of any of these materials to well-crystallized γ-Al_2O_3 is not conclusive evidence toward identifying the character of the starting material.

Therefore, based on the aforementioned points and the results of DTA and TGA evaluation [3] of the moist air and water grown Al/Hg reaction products, we are still led to the conclusion that the moist air grown material is best described as a molecular scale γ-Al_2O_3 with physically adsorbed water and not water of crystallization.

The suggestion by Bruce and West that the reaction in both gas and liquid phases has an electrochemical basis is very plausible and we certainly agree that mercury has a unique and specific action with aluminium. However, we must point out that we found the moist air reaction also occurs in moist nitrogen as previously reported [2]. Thus, to ascribe the single equation

$$2Al/Hg + n\,H_2O(g) + 1.5\,O_2 = Al_2O_3\,.\,n\,H_2O$$

to the reaction is still questionable in our minds both from the true nature of the reaction product and from the specific action of water vapour and oxygen in forming it.

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Surface preparation of MgO single crystal substrates

The surface condition of the magnesium oxide single crystal substrate in the epitaxial growth of ferrite is known to have an adverse effect on film quality. As-cleaved or as-sawn substrate surfaces are unsuitable because of cleavage and mechanical damage (see Fig. 1). We have found that a short manual polish of approximately 2 min with 400 and 600 silicon carbide papers followed by 1 h polishing treatments using a polishing machine with each of the following grades of diamond paste, 14, 6, 3, 1 and 0.25 μm, yields surfaces which are markedly smoother. Only shallow grooving and small surface protuberances are observed when these surfaces are examined in the scanning electron microscope. These surface features can be removed by chemical polishing. The most satisfactory chemical polish has been found to be orthophosphoric acid maintained at 170°C, with the specimen immersed for periods from 10 sec to 3 min. The surfaces produced in this way are flawless apart from minor pits (Fig. 2).

Some uncertainty exists regarding the most successful final polishing treatment of substrates for ferrite and garnet films. In some investigations a final treatment with Syton is claimed to be the most satisfactory technique for preparation of

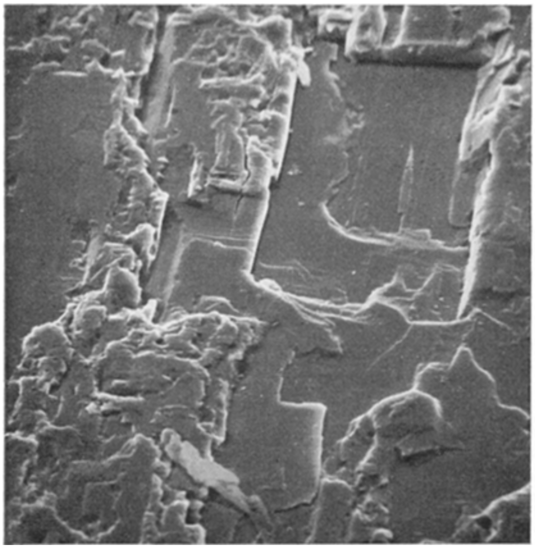

Figure 1 Scanning electron micrograph showing the surface damage produced by slicing MgO with a diamond impregnated wheel (approx. × 1200).

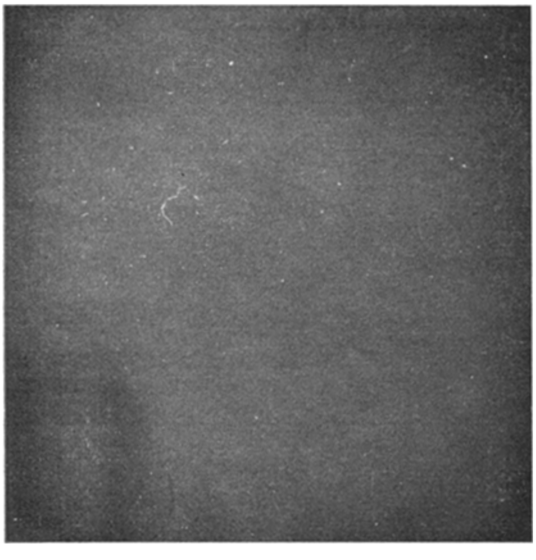

Figure 2 Scanning electron micrograph showing the surface texture after the initial polishing sequence is followed by a 3 min chemical polish in orthophosphoric acid at 170°C (approx. × 23 000).

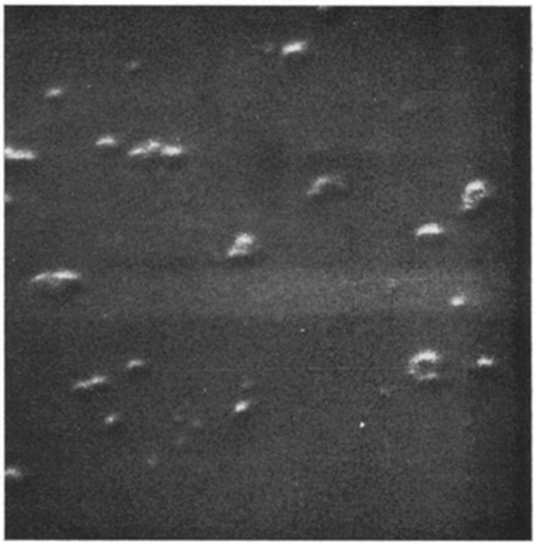

Figure 3 Scanning electron micrograph showing the surface texture after the initial polishing sequence is followed by a 1 h Syton polish (approx. × 26 000).

smooth surfaces [1] whereas in other studies [2, 3] a chemical polish in hot orthophosphoric acid is claimed to be more effective. However, until now, a high resolution comparison of the surface texture of substrates prepared by both techniques has not been made. We have studied this alternative final polishing treatment with Syton using the scanning electron microscope. The substrate surfaces have been found to contain a high density of small protuberances in this case (Fig. 3). We believe these protuberances result from solid particles which remain embedded in the substrate after polishing treatments. Our conclusion is that a chemical polish is superior to Syton as the final polish for MgO substrates.

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