

On the X-Ray Diffraction Patterns of  $\eta$ - and  $\gamma$ -Alumina<sup>1</sup>

Differences in the X-ray diffraction patterns of  $\gamma$ - and  $\eta$ -alumina, though small, are measurable and can be used to distinguish between the two if a sample is relatively pure. The most useful difference between the two powder patterns is evident at about 1.98 Å. While  $\eta$ -alumina has one strong line at 1.97 Å,  $\gamma$  has a doublet that appears as a strong line at 1.98 Å and a strong shoulder at 1.95 Å. Four syntheses of  $\eta$  by different workers (1-5) have all shown that it contains only a single line in this region, while in three syntheses of  $\gamma$  (1-4), a doublet is present. Unfortunately, the data in the Powder Diffraction File (PDF), published by the Joint Committee on Powder Diffraction Standards (JCPDS) (6), and used for distinguishing between the two, are misleading. Cards 4-875 and 10-425 of the PDF contain very similar patterns; however, the former is labeled  $\eta$ , and the latter  $\gamma$ -alumina. Two additional patterns on cards 29-63 and 29-1486 show minor differences from the first two but are called  $\gamma$ . Thus, all three cards in the PDF described as  $\gamma$  omit this doublet, and confu-

sion may result. Although many synthetic preparations may prove difficult to identify, if the characterization of the alumina is important, it may be more useful to show all or part of its diffraction pattern as a means of describing the alumina rather than simply calling it  $\gamma$  or  $\eta$ .

## REFERENCES

1. Wefers, K., and Bell, G. M., Technical Paper No. 19. ALCOA Research Laboratories, 1972.
2. Stumpf, H. C., Russell, A. S., Newsome, J. W., and Tucker, C. M., *Ind. Eng. Chem.* **42**, 1398 (1950).
3. Lippens, B. C., and DeBoer, J. H., *Acta Crystallogr.* **17**, 1312 (1964).
4. Brown, J. F., Clark, D., and Elliott, W. W., *J. Chem. Soc.* **13**, 84 (1953).
5. Searle, R., "X-Ray Diffraction Standards and Structures of Transition and Beta Aluminas." M. S. thesis, Alfred University, Alfred, N.Y., 1978.
6. Powder Diffraction File, Joint Committee on Powder Diffraction Standards, Swarthmore, Pa., 1979.

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