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Note on the crystallization of merwinite from glass of åkermanite composition

THE crystallization of a glass of åkermanite composition was studied by high-temperature microscopy combined with high-speed differential thermal analysis, as described by Mercer, Miller, and Sommer^{1,2,3}.

The sample was contained in the loop of a thermocouple microfurnace mounted in a water-cooled air-tight cell on the stage of a stereo microscope. A second thermocouple was used as a reference couple and the heat capacities of the two thermocouples were balanced by having a slightly larger junction on the reference couple. The Pt-Rh(5%)–Pt-Rh(20%) thermocouples used have a maximum operating temperature of approximately 1700° C. A twin-channel high-speed potentiometer recorder with

¹ Mercer (R. A.) and Miller (R. P.), 1963. *Journ. Sci. Instr.*, vol. 40, p. 352.

² Sommer (G.) and Miller (R. P.), 1964. *Govt. Metallurg. Lab., Project 46/44, Rept. no. 1, Johannesburg.*

³ Sommer (G.), 1965. *Instr. Techn. South Africa*, vol. 2, no. 2, pp. 7–16.

ranges of 0 to 12 mV for the temperature and -1 to $+1$ mV for the differential scale was used.

A sample of åkermanite was melted on to the thermocouple and the two couples were balanced at a temperature above the liquidus. The sample was then quenched by dropping water on to the molten material and simultaneously switching off the power to the thermocouples. The

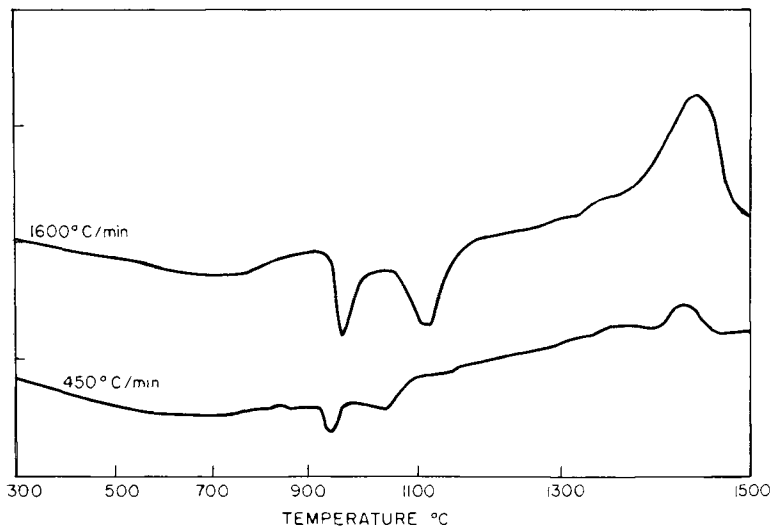


FIG. 1. D.t.a. curves of åkermanite glass.

temperature of the sample dropped from 1600°C to 100°C in 0.1 second and the quenched material was a glass. Air-quenching, achieved by switching off the power only, resulted in the same temperature drop in 4.25 seconds but the quenched material was often partly crystalline.

The differential thermal analyses curves of åkermanite glass are given in fig. 1. Heating rates of $450^{\circ}\text{C}/\text{min}$ and $1600^{\circ}\text{C}/\text{min}$ were used; the slower heating rate gave more accurate results. The melting point of åkermanite, as shown by fig. 1, is 1425°C . This value is near the melting point of 1434°C determined by visual observation, where the melting point is taken as the temperature at which a small crystal of åkermanite exists in the melt without decomposition or growth. Quenching of the heated glass from suitable temperatures and subsequent X-ray diffraction analysis of the quenched material showed that the first exothermic peak was caused by the crystallization of merwinite, $3\text{CaO}\cdot\text{MgO}\cdot 2\text{SiO}_2$, from the glass $2\text{CaO}\cdot\text{MgO}\cdot 2\text{SiO}_2$. This leaves a glass with the composition

of diopside, CaO.MgO.2SiO_2 . On further heating, åkermanite forms by reaction of the merwinite and glass residue and gives rise to the second exothermic peak on the d.t.a. curve. An endothermic peak appears when the åkermanite melts.

The above temperatures were obtained at a heating rate of 450°C/min . At a heating rate of 1600°C/min , these temperatures become 950°C and 1060°C respectively for the exothermic peaks and 1400°C for the endothermic peak (melting point). Heating rates slower than 450°C/min result in broad flattened-out peaks where it is impossible to determine the point of first deviation from the baseline as drift is always present. Slow step-wise temperature increases and observation through the microscope show that merwinite crystallizes from the glass after approximately 15 minutes at 830°C . The change of merwinite to åkermanite cannot be observed as the material is opaque after the first devitrification.

D.t.a. curves of partly crystalline åkermanite have only one devitrification peak corresponding to the second exothermic peak of fig. 1. This shows that åkermanite forms directly from the glass when crystallites are present. In this instance the peak area is of course smaller than when glass was used as a starting material.

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BOOK REVIEWS

HEINRICH (E. W.), *Microscopic identification of minerals*. New York (McGraw-Hill), 1965, xiii+414 pp. and coloured birefringence chart. Price: 84s.

The book aims at providing a text for the identification of rock-forming minerals in thin section, in crushed fragments (immersion method) and in detrital grains. Inevitably the book prompts comparison with *Optical Mineralogy* by Kerr (1959), which covers the same ground, appears in a similar format and is from the same publisher. Both books cover the main topics of a university course in determinative optical mineralogy and differ only in the relative treatment of theoretical aspects.