

slightly lower than that of the original glass. This decrease in the expansion coefficient is probably due to the existence of a low expansion surface layer. This phenomenon has been observed already [4–5]. The corrosion rate decreased to almost the same value of $33\text{Na}_2\text{O}\cdot 7\text{Al}_2\text{O}_3\cdot 60\text{P}_2\text{O}_5$ glass, indicating that most of the K^+ ions on the glass surface were replaced by Na^+ ions from the molten salt. Since the $33\text{Na}_2\text{O}\cdot 7\text{Al}_2\text{O}_3\cdot 60\text{P}_2\text{O}_5$ glass has lower expansion coefficient than $33\text{K}_2\text{O}\cdot 7\text{Al}_2\text{O}_3\cdot 60\text{P}_2\text{O}_5$ glass as shown in Table I, compressive stresses were expected to develop on the surface after cooling. Fig. 1 indeed shows the bright surface layer observed under a polarized optical microscope, indicative of the compression developed on the glass surface.

It can be concluded that the chemical durability of $33\text{K}_2\text{O}\cdot 7\text{Al}_2\text{O}_3\cdot 60\text{P}_2\text{O}_5$ glass was improved to almost the same value of $33\text{Na}_2\text{O}\cdot 7\text{Al}_2\text{O}_3\cdot 60\text{P}_2\text{O}_5$ glass while maintaining a high thermal expansion coefficient. The glass obtained in the present study has much higher expansion coefficient and slightly better chemical durability than that obtained in the previous study in which the $\text{Na}_2\text{O}\cdot 2\text{SiO}_2$ glass was ion-exchanged in LiNO_3 salt ($\alpha = 155 \times 10^{-7} \text{ }^\circ\text{C}^{-1}$, $K = 1.0 \times 10^{-5} \text{ g cm}^{-2} \text{ min}^{-1}$) [4]. By the proper choice of a bulk glass and the appropriate molten salts, it is possible to prepare other glasses of high expansion and good chemical durability by this method.

Acknowledgement

The authors are grateful to the Air Force Office of Scientific Research, Director of Chemical Science, for the support of this work under Grant AFOSR No. 75-2764.

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Received 18 September

and accepted 12 October 1978

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Chemical etchants to reveal old and fresh dislocations in MgO crystals

Most of the dislocation etchants of $\{100\}$ faces of MgO crystals reported in the literature [1–3] form shallower and often smaller etch pits at old dislocations. Because of the behaviour of the etchants, it is likely that several dislocations are either not revealed at all or go unobserved because of the shallowness and small size of etch pits. Consequently, the use of the reported etchants may lead to an erroneous picture of the dislocation density and distribution in MgO crystals. In this letter are reported several solutions of aliphatic acids that reveal fresh and old dislocations on $\{100\}$ faces of MgO crystals.

For experimental purposes we employed polished $\{100\}$ MgO surfaces. Initially formic, acetic and propionic acids of different concentrations were tried in the temperature interval 25 to 80°C . Formic acid below 7N formed shallow etch pits at old dislocations, while above 7N produced pyramidal elevations and therefore was found unsuitable. Acetic and propionic acids at low concentrations yielded a rough surface with shallow etch pits or pyramidal elevations similar to those formed by formic acid. At concentrations above 8.7 and 6.6N, acetic and propionic acids respectively, formed deep and contrastive etch pits, at sub-boundaries and in grains. These pits were of an equal size, more or less, to that of pits produced at slip bands (Figs.

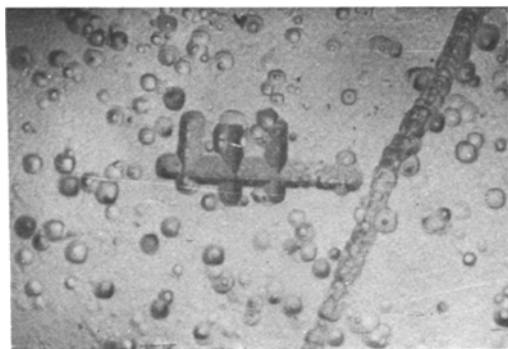


Figure 1 Etch pit pattern produced by 12.2 N acetic acid at 39.5° after 3 h, × 150.

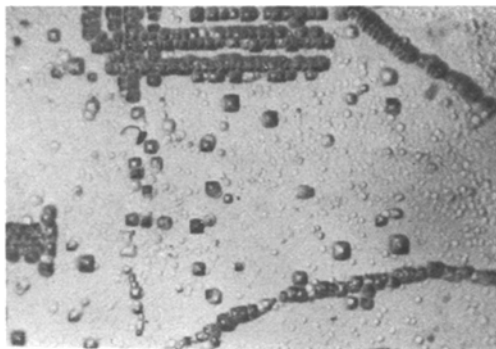


Figure 3 Etch pits produced by 6.6 N propionic acid at 76° C after 45 min, × 150.

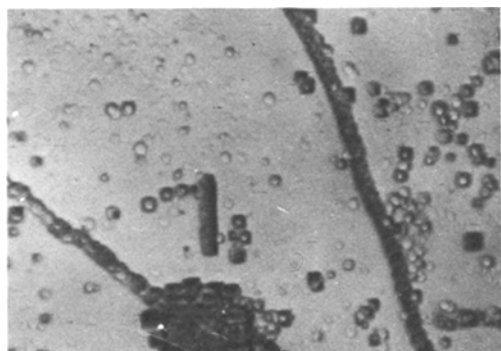


Figure 2 Etch pits formed by 9.2 N propionic acid at 66° C. Etching time 1½ h, × 150.



Figure 4 Etch pattern formed by 6.6 N citric acid at 51° C after 1 h 10 min, × 150.

1 and 2). Etching temperature and duration did not observably change the etch pit pattern (Fig. 3). However, longer etching times were required at lower temperatures and at very high concentrations. Etching time for propionic acid was also found to be longer than that for acetic acid of the same concentration.

3.3 and 6.6 N oxalic and citric acid solutions, and 4.95 and 9.9 N tartaric acid solutions were also tried at 51° C. Oxalic and tartaric acids formed elevations while 6.6 N citric acid revealed fresh and old dislocations equally with the formation of somewhat shallower etch pits (Fig. 4).

Acknowledgements

The authors thank Professor A. R. Patel for his interest in the work and to Norton Research Corporation, Canada, and Dr A. Briggs, AERE Harwell, for the crystals.

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Received 20 September
and accepted 12 October 1978

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