

Electrochemical etching of Si in KOH electrolytes

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Si etching in aqueous KOH is of both technological and fundamental interest. The etch rate depends on Si crystallographic orientation and doping ^[1]. Etching of Si (100) wafers in low concentrated alkaline solutions (< 2 M) at high temperatures (>50 °C) forms pyramidal hillocks on the surface, randomly oriented and distributed in multicrystalline materials ^[2]. The isotropic etching avoids the etch rate differences between crystallographic orientations. Etching in HF/HNO₃ solution is the best known process for this purpose; nevertheless, it is dangerous to handle and the cost of HF and its chemical disposal are expensive ^[2].

This work proposes to modify the anisotropy of etching in KOH, applying electric field. So far, there are just a few reports about it, mainly aiming electropolishing ^[1]. In the present contribution, sections to be etched are defined by photolithography, using thermal SiO₂ as a masking layer. The pattern used is of holes of 360 microns in diameter.

The samples were subjected to 2 specific voltages, taking the open circuit potential (OCP = -0.9 V) as a reference. Fig. 1 and 2 show the surface of samples etched during 4 h to -0.6 V. The pattern of holes can be observed, where each of the holes presents an isotropic morphology. When etching at 25 V for 4 h, part of the surface is anisotropically etched, while another region is electropolished (Fig. 3). Applying 30 V for 2 h, the material is etched more vigorously, which produces a hole through the sample, with pyramidal hillocks around the hole (Fig. 4).

A dependency of the etch rate on the electric potential and the physical-chemical behavior

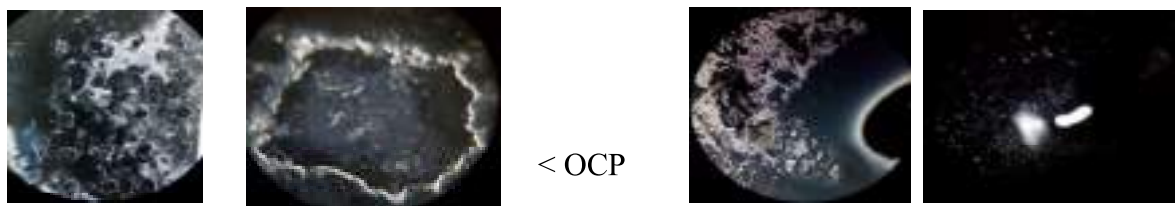


Fig. 1 Etching at -0.6 V

Fig. 2 Close up of Fig. 1

Fig. 3 Etching at 25 V

Fig. 4 Etching at 30 V

in the Si / KOH interface is inferred. For -0.6 V the etch rate is 0.013 μm/min, while to 25 V the etch rate is about 0.069 μm/min.

References

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