In wet silicon anisotropic etching the shape and size of the microstructures are restricted by the crystallographic properties. The fabrication of rounded concave and sharp edge concave corner is a challenging task. The present research focuses on the development of microstructures with rounded concave and sharp-edged convex corners on (100)-silicon wafer in a single step wet anisotropic etching process. By providing rounded concave corner instead of sharp one, the stress can be smoothening, and that will improve the mechanical efficiency of the microstructure. However, the fabrication of this type of geometry is difficult as severe undercutting start at convex and rounded concave corners during wet anisotropic etching.

To realize the aforementioned types of microstructures on (100)-silicon wafers, the etching characteristics of TMAH solution with non-ionic surfactant NC-200 are analyzed. The NC-200 contains 100% polyoxymethylene -alkyl-phenyl-ether. The present study also aims to optimize etching condition for better etched surface finish with reasonable etch rate and minimum undercutting at convex and rounded concave corners.

Fig. 1(a) and 1(b) show the SEM photographs of fabricated structures in 25 % TMAH solution without and with surfactant at 60°C, respectively. It can be easily seen that the undercutting at convex as well as rounded concave corners reduces drastically when the surfactant NC-200 is added in the solution. The Average convex undercutting ratio \( \frac{l}{d} \) in pure and surfactant added 25% TMAH solution at 60°C is shown in Fig. 2. This ratio in NC-200 added 25% TMAH solution reduces by 92% which is less than the values reported for IPA and other surfactant added TMAH solution. The addition of this surfactant also improves the quality of etched surface especially when low concentration TMAH solution is used.

The design of cantilever beam for MEMS application requires thickness of about 2–10 μm. However, in this work, we have achieved rounded concave and sharp edge convex corners with negligible undercutting up to 20 μm without adding any compensating structure. If it is required to make the structure with large thickness, very space efficient corner compensating structure can be used.

**Figure 2** The comparison of undercutting ratio (l/d).

**Publication List**

**Journal Papers**

**Presentation at International Conferences**