Anisotropic Etching Characteristics of Silicon in TMAH:IPA:Pyrazine Solutions

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This paper presents anisotropic etching characteristics of single-crystal silicon in tetramethylammonium hydroxide (TMAH):isopropyl alcohol (IPA) solutions containing pyrazine. With the addition of IPA to TMAH solutions, etching characteristics are exhibited that indicate an improvement in flatness on the etching front and a reduction in undercutting, but the etch rate on (100) silicon is decreased. The (100) silicon etch rate is improved by the addition of pyrazine. An etch rate on (100) silicon of 0.8 $\mu$m/min, which is faster by 13% than a 20 wt.% solution of pure TMAH, is obtained using 20 wt.% TMAH:0.5 g/100 ml pyrazine solutions, but the etch rate on (100) silicon is decreased if more pyrazine is added. With the addition of pyrazine to a 25 wt.% TMAH solution, variations in flatness on the etching front were not observed and the undercutting ratio was reduced by 30–50%.