FUJIFILM

Mixed Acid Etchants

• Mixed Acid Etchants (MAE) are used primarily to etch silicon (single and poly - crystalline), but can be used for a variety of applications, such as doped silicon etching.

• The etch rates for mixed acid etchants are affected not only by etchant composition, but also by substrate movement, crystal orientation, and dopant type and level.

• The most common type of processing takes place in an immersion bath at room temperature, and use in spray tools has also been noted.

• Mixed acid etchants are mixtures of nitric acid, hydrofluoric acid and acetic acid and/or water.

• The reaction is comprised of two steps when used to etch Si. This reaction may be written as:

$$3Si + 4HNO_3 + 18HF \rightarrow 3H_3SiF_6 + 4NO + 8H_2O$$

• In the initial part of the reaction, the nitric acid acts as the oxidizing agent, which forms a layer of oxide on the silicon. In the second part the hydrofluoric acid acts as the complexing agent, which dissolves the oxide away, thereby displacing the silicon into the dissolved solution.

• The two part reaction can be limited by controlling one of the two steps while maintaining an excess of the other. In solutions in the high HNO3 composition region, the concentration of the HF determines the particular etch rate. The rate is limited by the ability of the HF to remove the excess oxide during the reaction.

In a solution of the high HF composition region, the concentration of the HNO3 determines the etch rate, by controlling the oxidation step which is the limiting reaction. Although water can be used as a diluent, acidic acid (HAC) is typically used which causes less dissociation of the nitric acid yielding higher amounts of the undissociated species.

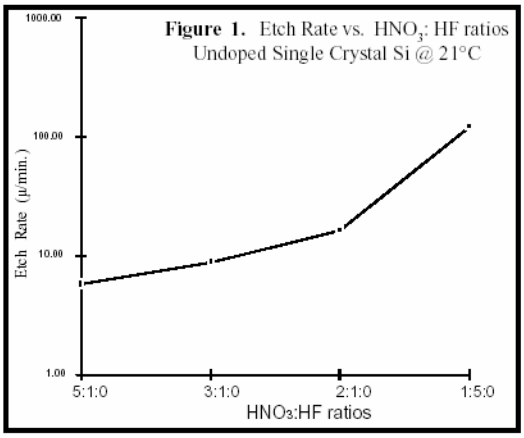
Etching should be conducted in HDPE, Teflon® or other fluorocarbon containers.

Since mixed acid etching is designed to be performed at room temperature or slightly below, it is recommended that bath temperatures be carefully controlled to minimize fluctuation in the etch rate.

Two component solutions contain HNO3 and HF, and tend to be more aggressive than the same ratios in the three component solutions due the absence of the diluent.

The three component mixture contains HNO3, HF and HAC.

Mixed Acid Etchants - Two Components



Mixed Acid Etchants - Three Components