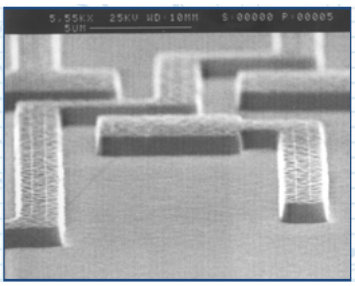
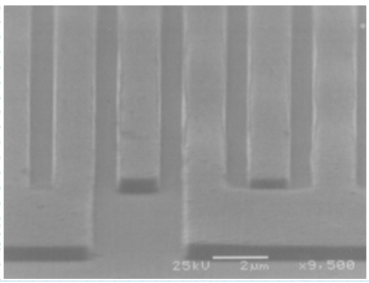
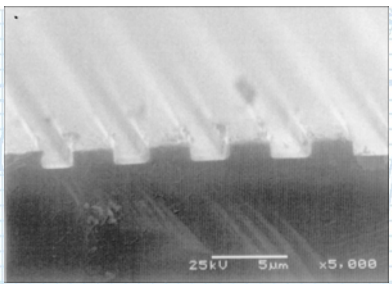
Aluminium Etching



AlSi (1%) Etch Using $SiCl_4$ etched at 475nm/min (after oxygen ash and sovent rinse)



500nm Al line on LiTaO3 etched at 430nm/minusing HBr process with Cl_2 initiation (oxygen ash and solvent rinse)



Al Etch on silicon @ 420nm/min Cl_2 Initiation & HBr Etch Step

Chlorine reacts spontaneously with aluminium once the native oxide (Al_2O_3) is removed. The etch rate is fast, but the process is isotropic if there is no ion bombardment present.

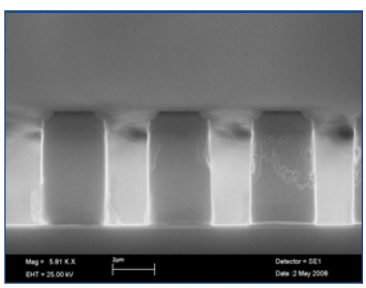
Anisotropic etching of Al is achieved using ion-enhanced etching with the addition of a gas that forms a surface inhibitor layer. This is practically achieved by adding $SiCl_4$ or BCl_3 to the Cl_2 etch chemistry. Unfortunately, this approach can result in limited selectivity to the PR mask and underlayers (such as TEOS). Such processes are susceptible to significant post etch corrosion. This can be managed through additional plasma processes..

To increase selectivity of aluminium to photoresist or dielectric underlayers, it is possible to use HBr. The disadvantage is that it etches the native oxide layer at a slower rate than Cl_2

Therefore, a two step etch has been designed to exploit the advantages of both gases.

- Use of HBr also helps prevent post etch corrosion of the Al
- Corrosion occurs when residual chloride compounds hydrolyze with ambient moisture after removal from the etching system.
- The hydrolysis reactions form hydrochloric acid (HCl) which attacks the imperfectly re-oxidised sidewalls of the aluminium conductor.
- The use of HBr as the primary etch gas reduces HCl formation.
- However,
  - Only catalytic amounts of chlorine are required to initiate and sustain these reactions
  - the photoresist can contribute to this by absorbing large quantities of chlorinated species then acting as a source of chloride ions when the wafer is exposed to ambient conditions
- Therefore even using HBr, post etch corrosion treatments are required

5µm deep Al etch



Etch Rate (nm/min)	550
Uniformity (%)	<5
Selectivity to mask (Al:PR)	4:1
Selectivity to oxide (Al: Thermal SiO2)	19:1
Profile angle (°)	89

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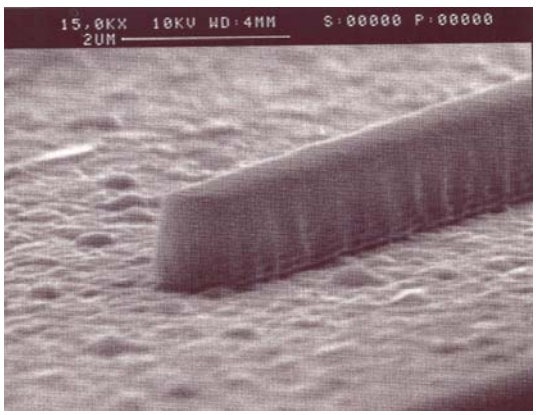
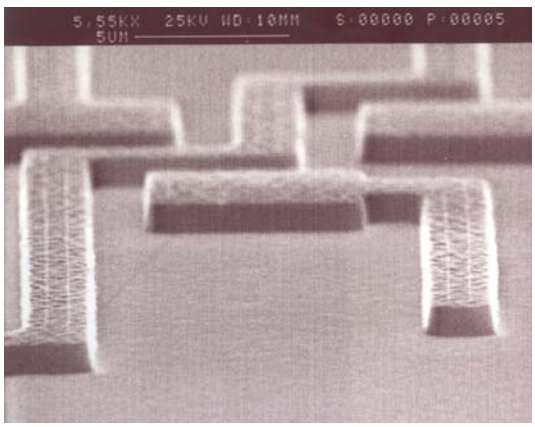
AlSi (1%) Etch Using $SiCl_4$



Sample Pre Etch



After Etch O_2 Ash & Solvent Rinse

- **Application**
  - Feature: 0.8 -1 µm line
  - Etch Depth: 1 µm
  - Substrate: Silicon
  - Underlayer: TEOS
  - Wafer Size: 100 mm
  - Mask: 1.2 µm resist
- **Results**
  - Chemistry: $SiCl_4$
  - Etch rate: 475 nm/min
  - Uniformity: ± 2.8%
  - Profile: 87°
  - Selectivity $_{Al:PR}$: ~2:1
  - Selectivity $_{Al:TEOS}$: >5:1

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