Gallium Phosphide Etching

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Group meeting presentation
Overview

• Motivation: to create a network of qubits based on nitrogen vacancies.
Background Info

• Not much literature on GaP chemical etchants compared to other semiconductors

• Etch quality ranges widely between chemicals [1]
Experimental

• Procedure: Chemical etchant, measure, etch sample

• Equipment: Alpha-Step, Fume hood, clean room

• Troubles: Alpha-Step friction, chemical containers
• High photoresist damage

• Compared to other etchants, largest etch rate
• Moderate photoresist damage
• Lower etch rate
• Peculiar results at first

• Still decreased etch rate
• Etch rate comparable to 1:1 solution
• Not much damage to photoresist
• Slow but consistent

• Damage to photoresist somewhat different than other samples
Summary

- Etch rates lower than literature results, due to insufficient chemical volume.

- Generally, the higher the proportion of HCl to HNO$_3$, the slower the etch rate.

- Photoresist mask on the samples did not come off all the way on any of the samples and only sustained serious damage on the 1:1 and 2:1 samples.
Where to go

• (K$_3$Fe(CN)$_6$) and (KOH) etchant [2]
  – ~220 $\mu$m/hour
  – $GaP+4KOH+3K3Fe(CN)6 \rightarrow K[Ga(OH)4]$
  – Polished surface without preferential etching

• Stabilized acetic acid and aqua regia [1]
  – Supposedly gives smooth etch surface
  – Slower etch than pure aqua regia