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High Aspect Ratio Deep Trench Etching

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- Significance: MEMS, 3D NAND, Waveguides, TSV
- Processes to achieve deep HAR trenches
  - Cryogenic Deep Reactive Ion Etch
  - Bosch Deep Reactive Ion Etch
- Three main problems
  - Etch rates
  - Wall profiles
  - Equipment Design

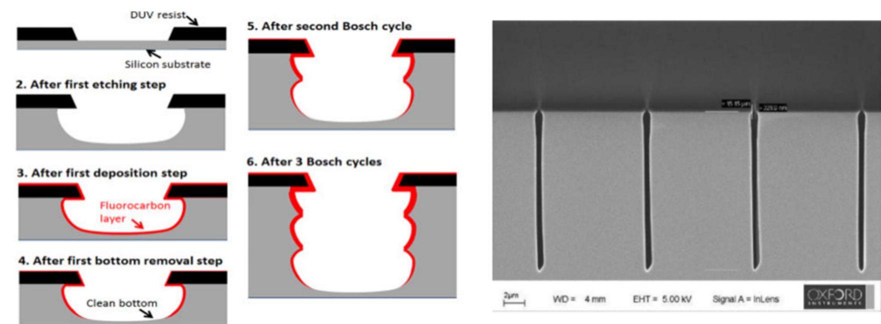

Figure 18. 300nm features etched >15μm deep (AR 50:1)

Class Learnings: Many controllable parameters

- Plasma density/Ion flux
- Substrate biasing
- Gas chemistries
- Plasma system design

Solutions:

- Faster cycling in Bosch processing
- Combining Standard Etch/Bosch
- Post etch processing: Bosch + Sidewall smoothing
- Laser enhanced Cryogenic etching

1.Chang *et. al.* DREM: Infinite etch selectivity and optimized scallop size distribution with conventional photoresists in an adapted multiplexed Bosch DRIE process Microelectronic Engineering Volume 191, 5 May 2018, Pages 77-83
2. Oxford instruments plasma technology Comparison of the Bosch and Cryogenically Cooled Deep Silicon Etch Processes. Feb. 2012