

Silicon Deep RIE/ICP – Bosch

Si- DRIE



Plasma-Therm 770 SLR

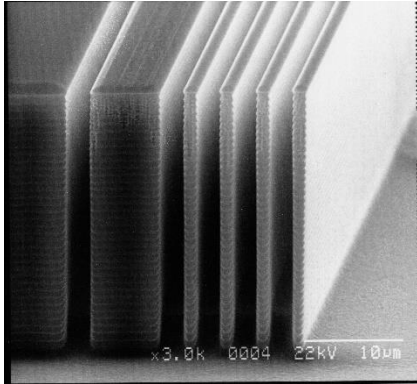
- Fluorine-Based Bosch Process (Cyclic etch/dep process)
- 1kW, 2 MHz ICP source, 4" wafers, 500 W Sample Bias
- Pieces mounted with Diff Pump Oil: Santovac 5 (Polyphenyl Ether) or thermal tape
- He cooling, ceramic clamp
- Si-deep etching for MEMS
- > 3um/min etch rates possible
- SF₆, C₄F₈, O₂, Ar, N₂
- PR, SiN, SiO₂, Al₂O₃ masks
 - Selectivity up to 300:1 with thermal oxide
 - Up to 80:1 with PR

20 minute Bosch Season run done before etch if system idle for more than 30 minutes.

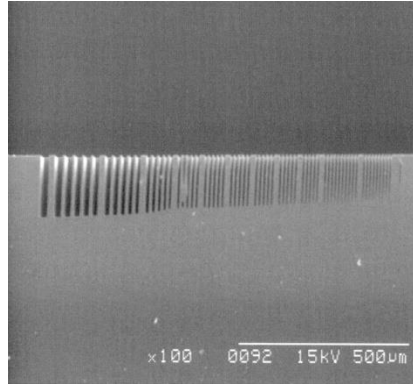
Wet cleans done on as-needed basis.

SF₆/Ar release etches also done in the system.

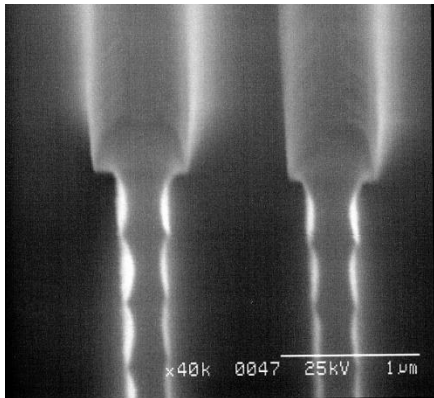
Si Etching (Bosch Process) – ICP



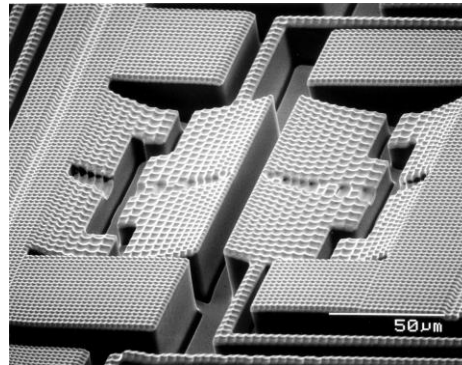
Typical Standard Bosch Process
~ 1-2.5µm/min etch rate (loading)



ARDE of Bosch Process



Bosch Scalloping due to
Cyclical Process



Single-Step-3D
Micromachining by
Controlling ARDE through
parameter adjustment and hole
opening (M. Rao)

Standard Recipe:

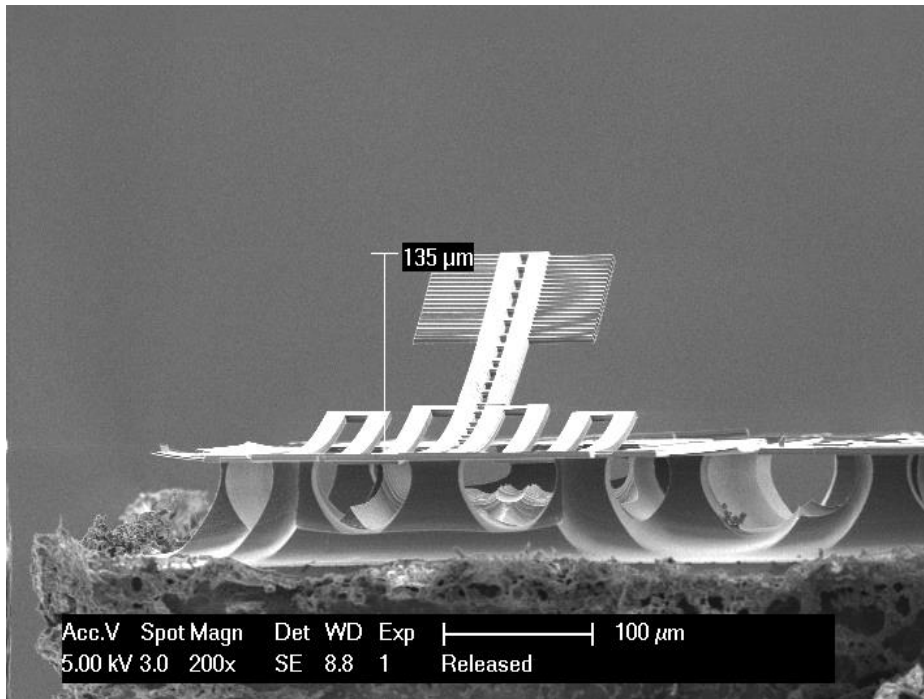
- ICP power 825 W
- 23 mTorr
- Coil Temp: 40 C
- Sub Temp: 10 C (mounted parts)
- Sub Temp: 20 C (4" wafers)

- EtchA: SF6/Ar 50/40, Bias 9W, 2 "
- EtchB: SF6/Ar 100/40, Bias 9W, 6 "

- Dep: C4F8/Ar 70/40, Bias 0W, 5 "
 - reduce C4F8 flow and dep time if grassing issues

Lots of In-house parameter characterization

Release Etch Si-ICP



Release Etching standard CMOS
process MEMS structures

$\Delta t=9\text{min.}$ B. Thibeault

Standard Release:

- ICP power 825 W
- 23 mTorr
- Coil Temp: 40 C
- Sub Temp: 10 C (mounted parts) 20C (wafers)
- SF6/Ar 100/40
- Bias 9W
- Vertical Rate ~9um/min.
(Small Area)
- Lateral Rate ~4um/min
(Wide opening)