Inspecting Laser Micro-machined Si Tips for Current Injection into Liquid Xenon

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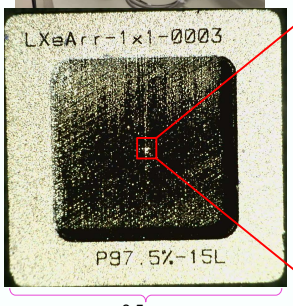
Introduction

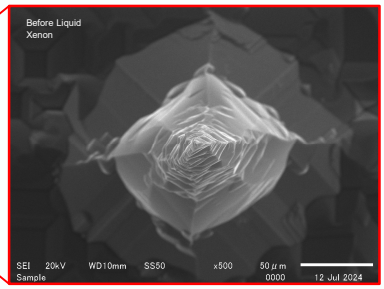
- Current was successfully injected into liquid xenon through a single n-doped silicon tip (see Caio's poster #20 for details).
- The stability of the tip's structure is investigated using the digital optical microscope (DOM) and the scanning electron microscope (SEM).

Scanning Electron Microscope

- Large depth of field
- High resolution
- Avoids lighting flares and shadows that can cause artifacts
- Downside: requires hours of vacuum pumping before using

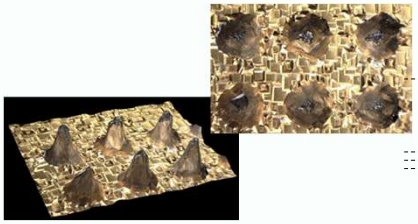


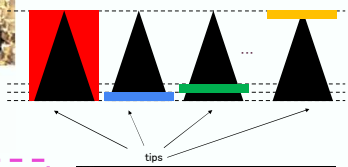
8.5 mm



Digital Optical Microscope

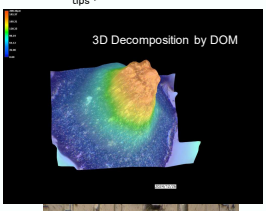
- Can observe uneven surfaces and 3D objects with clear images despite having small depth of field
- Captures images at different focus distances and combines the sharpest parts to create a fully focused image



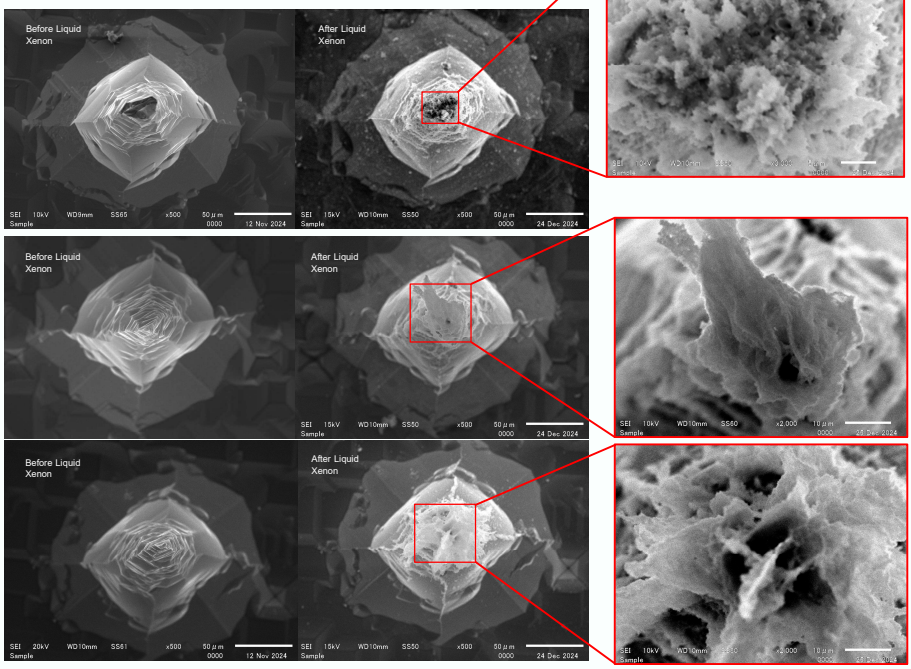


After Field Emission in Liquid Xenon

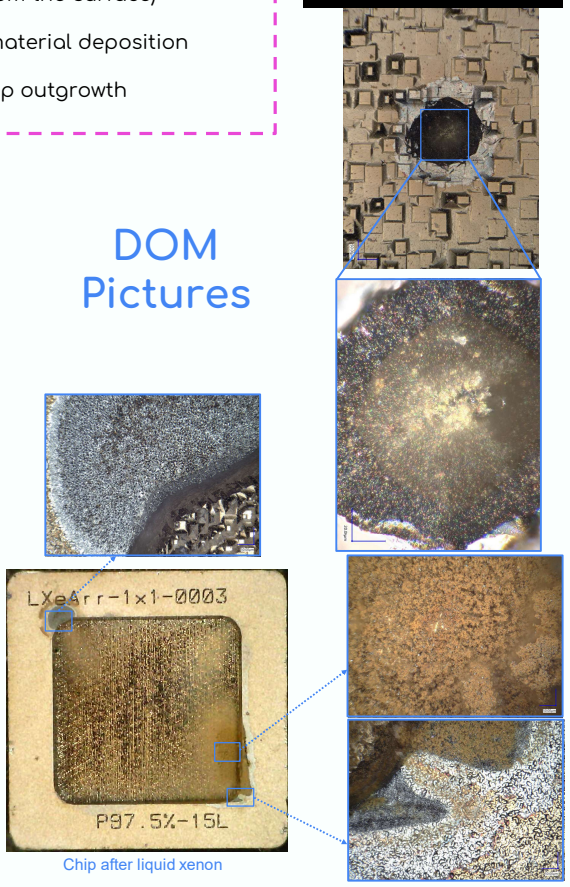
- Edge damage
- Coating loss (Copper coating blown off from the surface)
- Fuzzy material deposition
- Tip outgrowth



SEM Pictures

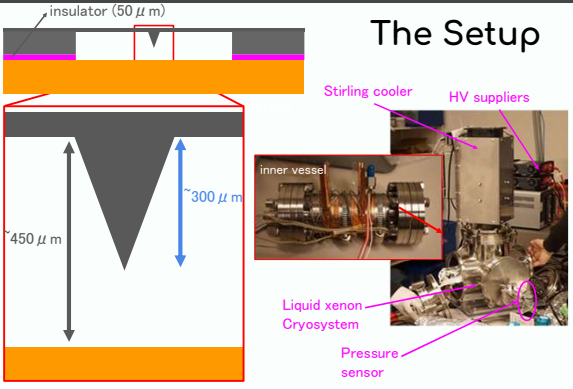


DOM Pictures



Chip after liquid xenon

The Setup



Discussion

- Brownish material of unknown composition was found: Amorphous Silicon ?
- Outgrowing structure was formed.
- Need to reduce the deformation of tips, potentially by trying a different material of the tip such as copper.
- Examine and improve our setup: coating is not necessary
- Need to repair the Energy dispersive X-ray spectroscopy (EDS) that is attached to the SEM to study elemental composition.

The provider of the silicon FEA chips is from OTH Regensburg

Recent Reference: Journal of Vacuum Science and Technology B 42,012201 (2024)