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Manufacturing of void-filled Cu samples for breakdown experiments in the DC spark setup

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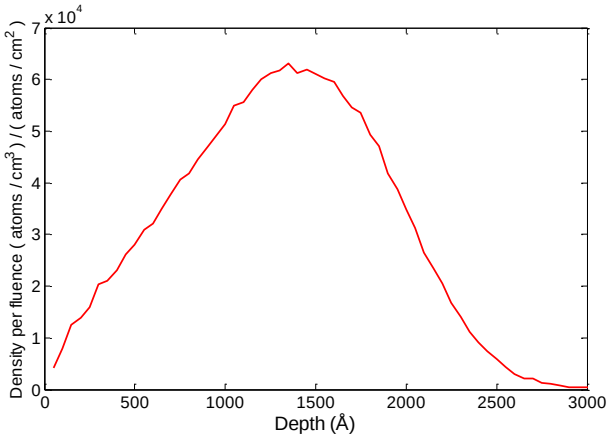
Motivation

- Simulation work (Aarne Pohjonen, Stefan Parviainen) suggests that voids under the surface of the cathode are a significant cause of breakdown
- This result can be tested empirically in the DC spark setup if we have samples with voids
- We are manufacturing samples in Helsinki:
  - He ions implanted into the sample by irradiation (done!)
  - He is nucleated into bubbles and then removed through annealing, leaving behind voids
  - The successful creation of voids is confirmed through positron annihilation spectroscopy

Irradiation

- Relationship between implantation depth and ion energy was studied with SRIM:



SRIM simulation of He ion implantation into Cu sample, ion energy of 30 keV

- Irradiation of samples was conducted using ion energy of 30 keV, dose chosen to yield 5 at% He at most common stopping range

- Each of the 12 samples had half of it masked with aluminium tape to provide a control sample

Annealing (planned)

- Implanted He tends to form small (<10 atoms) clusters around metal lattice vacancies
- Significant diffusion needed to make He nucleate into bubbles, as well as leave sample
  - Annealing likely needed
- Plan: Leave 4 samples un-annealed, anneal the rest using lowest reasonable temperature (to prevent blistering)
- Use positron annihilation spectroscopy to verify successful manufacture of voids