Fabrication technologies for chip-based superconducting traps

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Introduction

Magnetic levitation has been shown to be a novel platform for greatly decoupling the center-of-mass motion of a levitated superconducting particle from its environment [1]. As a result, the experimental platform we develop will enable novel, ultra-sensitive **force and acceleration sensors**, as well as **quantum experiments** with macroscopic objects of 10^{13} atomic mass units. The latter could shed new light on the transition from quantum to classical behaviour via, e.g. proposed unconventional decoherence mechanisms outside the established formalism of quantum mechanics [2].

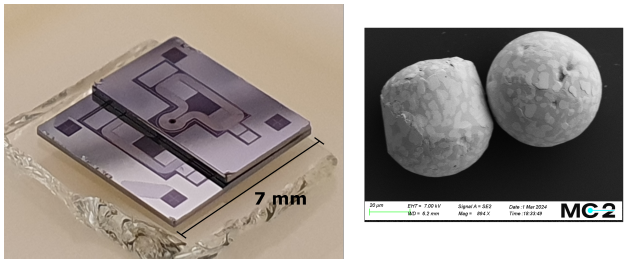

*Figure 1: **Left**: A photograph of the trap, showing the assembly of the trap from two chips. **Right**: SEM images of the particles we levitate.*

In our experiments [3], we employ chip-based magnetic traps to levitate **superconducting microparticles**. The trap is assembled from two chips stacked on top of each other, as in Figure 1.

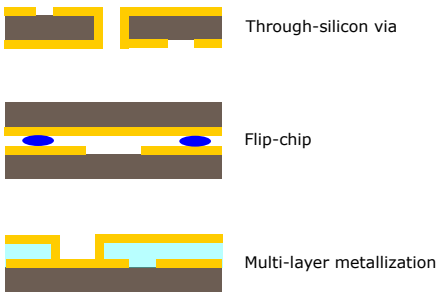

Figure 2: Different possible fabrication strategies for improving the performance of the superconducting magnetic traps.

In order to improve the performance of the magnetic traps, there are several alternate possible geometries which would require development of new fabrication processes to realize. Such new processes could consist of **through-silicon vias** [4], **flip-chip** [5] or **multi-layer metallization** (all shown in Figure 2).

The project

You will develop a novel process in order to improve the performance of the magnetic traps used in our experiment. Samples incorporating your process will be characterised at room-temperature and eventually at cryogenic temperatures in our lab. The thesis goal will be to use your developed process for a magnetic trap of your own design.

What we offer you

- Develop a novel process for superconducting devices in the MC2 cleanroom
- Experience operating and performing measurements in a cryostat
- Team-work in a stimulating research environment

What you offer us

We seek a motivated student taking their own initiatives to drive the project forward. Experience with work in a cleanroom or chemistry lab is not necessary, but beneficiary. After introduction to the Nanofabrication laboratory from us and the staff, you will be working independently in the cleanroom.

Contact

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