Fabrication technologies for chip-based magnetic traps

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Introduction

Magnetic levitation has been proposed as a novel platform to greatly decouple 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, ultrasensitive **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].

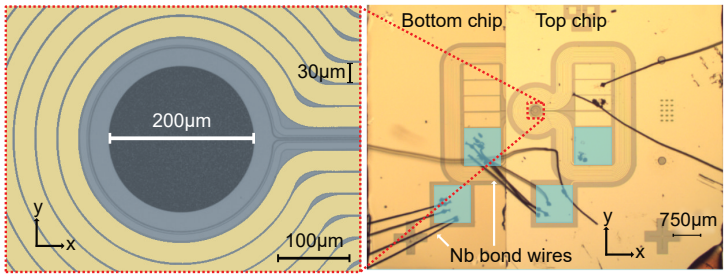

Figure 1: The trap chips under the microscope. Left image shows zoomed in trap region, right image shows the entire magnetic trap.

In our experiments [3], we employ chip-based magnetic traps to levitate superconducting microparticles (see Figure 1). The trap is assembled from two chips stacked on top of each other, as in Figure 2.

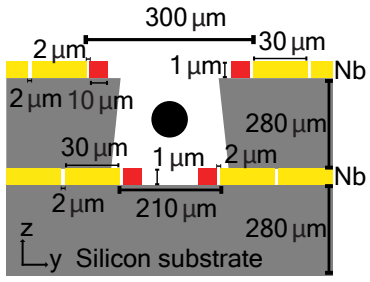

Figure 2: A profile of the trap, showing the assembly of the trap from two chips.

A natural evolution of the trap geometry is to use one chip patterned on both sides. This is possible provided that supercurrents can be transported from one side of the chip to another, using **through-silicon vias** (TSVs). TSVs are widely used in the semiconductor industry and have been developed with superconductors for qubit control lines [4].

The project

You will develop a process for fabricating superconducting TSVs capable of supporting large supercurrents. The superconducting properties of the vias will be measured at cryogenic temperatures in our dilution refrigerator. You will then develop a new trap design based on your via technology which will be used to levitate microparticles.

What we offer you

- The chance to 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 expect you to take own initatives to drive your project forward. After introduction to the cleanroom from us and the staff, we expect you to be able to work independently with your processes.

Contact

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