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Microfabrication of Surface Electrode Ion Traps for Quantum Information Experiments YUFEI GE, JAROSLAW LABAZIEWICZ, PAUL ANTOHI, ISAAC CHUANG, MIT — Surface electrode ion traps, while promising for large-scale quantum computation, have long been challenged by ion heating rates which increase rapidly as trap length scales are reduced. Through a series of measurements on over fifteen traps, we show that ion heating rates are surprisingly sensitive to electrode material and morphology, and in particular, to details of the fabrication procedure. For example, one 75 μm size trap, made of chemically etched silver on a single crystal quartz substrate, showed a minimum heating rate of ~ 40 quanta/second, when prepared by annealing at 760°C in vacuum for one hour. This annealing smooths sharp edges, and significantly reduces breakdown voltage. However, if the annealing temperature is lowered to 720°C, leaving the breakdown voltage still robustly high, the heating rate jumps to ~ 1000 quanta/second. With electroplated gold, on a silver seed layer, a record low heating rate of ~ 2 quanta/second is obtained. We present details of the fabrication procedures, evaluate alternative electrode materials such as niobium nitride, and explain how these measurements were obtained with an ion trap operated at 6 Kelvin, containing a single strontium ion, sideband cooled to its quantum ground state of motion.

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