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Decoherence of trapped ion states in passivated aluminum ion traps YUFEI GE, SHANNON WANG, NATHAN LACHENMYER, 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. Existing research shows that ion heating rates are surprisingly sensitive to electrode material and morphology. Here, we report on a new experiment measuring the heating rate out of the motional quantum ground state of a single Sr^+ ion in an aluminum ion trap operated at cryogenic temperatures. Aluminium naturally and nearly immediately forms a tough, resistant, surface oxide, alumina, which protects it from further oxidation. Compared to other metal ion traps, aluminum ion traps are more difficult to compensate, and often have short ion lifetimes, perhaps due to this nanometer-thick alumina layer. A series of aluminum traps with different and controlled alumina layer thickness are fabricated and evaluated. We discuss the ion heating rate versus the oxide layer thickness and investigate whether the heating rate is more related to bulk or surface properties.

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