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Reducing Motional Decoherence in Ion Traps with Surface Science Methods

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Many trapped ions experiments ask for low motional heating rates while trapping the ions close to trapping electrodes. However, in practice small ion-electrode distances lead to unexpected high heating rates. While the mechanisms for the heating is still unclear, it is now evident that surface contamination of the metallic electrodes is at least partially responsible for the elevated heating rates. I will discuss heating rate measurements in a microfabricated surface trap complemented with basic surface science studies. We monitor the elemental surface composition of the Cu-Al alloy trap with an Auger spectrometer. After bake-out, we find a strong Carbon and Oxygen contamination and heating rates of 200 quanta/s at 1 MHz trap frequency. After removing most of the Carbon and Oxygen with Ar-Ion sputtering, the heating rates drop to 4 quanta/s. Interestingly, we still measure the decreased heating rate even after the surface oxidized from the background gas throughout a 40-day waiting time in UHV.