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Probing surface-mediated decoherence with nitrogen vacancy centers ALEC CAO, XUE HAN, YUANQI LYU, AARON WATSON, University of California, Santa Barbara, SHUO MA, Princeton University, YI ZENG, California Institute of Technology, KUNAL MUKHERJEE, ANIA JAYICH, DAVID WELD, University of California, Santa Barbara — Surface-mediated decoherence is a central obstacle to the development of quantum technologies. Quantitatively characterizing this decoherence requires attaining control over surface adsorbates coupled to a qubit-like degree of freedom. We have constructed an apparatus that allows reversible in-situ adsorption of indium atoms onto a diamond surface in UHV and direct measurement of adsorbate interactions with shallow subsurface nitrogen vacancy (NV) centers. Measuring NV spin properties at varying adsorbate densities, we observe adsorbate-induced decreases in T1, as well as a reduction in the contrast of Rabi oscillations. Exposure to a nanosecond pulsed laser partially reverses the effects. These results constitute progress toward reversible quantitative control over adsorbate-induced surface decoherence, and motivate the development of a cryogenic UHV decoherence probe station with in-situ surface preparation tools, the design of which we will briefly discuss.

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