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Microfabricated surface trap for scalable ion-photon interfaces PETER HERSKIND, SHANNON WANG, MOLU SHI, YUFEI GE, MARKO CETINA, ISAAC CHUANG, MIT — The combination of high-finesse optical mirrors and ion traps is attractive for quantum light-matter interfaces, which represents an enabling resource for large-scale quantum information processing. We report on a scalable approach to ion-photon interfaces based on a surface electrode ion trap microfabricated on top of a highly reflective mirror. An aperture in the central electrode, directly below the ion, allows the mirror to interact with the ion. The integration of such mirrors is scalable as several mirror apertures may be added with no additional overhead for fabrication. Furthermore, the design provides a path for reaching the strong coupling regime of Cavity QED, where an ion-cavity system can be realized by adding a small concave mirror above the trap mirror. The quality of the mirror is not significantly compromised in the course of fabrication and we have measured an increase in losses for light at 422 nm at the level of 100 ppm. The functionality of the mirror has also been verified by light collection from, and imaging of, the ion 169 ± 4 μm above the mirror. Despite its proximity, we find that the presence of the mirror does not perturb the trap. Trapping is stable with laser cooled ion lifetimes of several hours and we observe only minimal sensitivity to laser-induced charging. Furthermore, through operation of the trap in a cryostat at 15 K the heating rate of the ion is a the level of only 0.1 quanta/ms.

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