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Addressing surface-induced loss and decoherence in superconducting quantum circuits ANDREAS FUHRER, PETER MUELLER, ANDREAS KUHLMANN, STEFAN FILIPP, VEERESH DESHPANDE, UTE DRECHSLER, IBM Research - Zurich — Many of the advances in coherence and fidelity of superconducting qubits have been made possible by clever engineering of the coupling to the environment and operation at noise-insensitive sweet spots. However, this leads to a compromise in experimental flexibility and device tunability, which can become inhibitive as the system size is scaled up. Material and interface related degrees of freedoms are harder to mitigate and are expected to become increasingly important in more complex systems. They impose limits both on coherence (flux-noise) and lifetimes (surface loss) of superconducting qubits. To study and eliminate these effects we have constructed a reusable UHV-compatible sample enclosure that enables us to perform various surface passivation steps before cooling superconducting devices to cryogenic temperatures. The enclosure can accommodate large chips with up to 18 microwave ports and can be vacuum sealed at pressures below 8e-10 mbar. We discuss its operation principle and present first measurement results of superconducting CPW resonators and qubit devices with and without prior surface treatments.

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