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**Thin film processing of Re/Al<sub>2</sub>O<sub>3</sub>/Re/Ru epitaxial trilayers into superconducting qubits<sup>1</sup>** JEFFREY S. KLINE, FABIO DA SILVA, DAVID S. WISBEY, MICHAEL R. VISSERS, DAVID P. PAPPAS, National Institute of Standards and Technology, Boulder, Colorado — We present a new recipe for processing thin film Re/Al<sub>2</sub>O<sub>3</sub>/Re/Ru epitaxial trilayers into superconducting qubits. To maintain compatibility with current in-plane tunneling (CIPT) measurements, we use a thin top electrode consisting of 30 nm Re and 5 nm Ru. The Ru cap protects the Re film underneath from tarnishing when exposed to atmosphere and has an electrically conductive native oxide. The Ru cap also protects the mesa from unwanted etching during the overetch portion of the CHF<sub>3</sub>+O<sub>2</sub> reactive ion etch (RIE) used for the via etch of the SiO<sub>2</sub> insulator layer. Unintentional sidewall redeposition of base and top electrode material during the mesa etch is avoided through the use of a two step process. First the Ru cap is argon ion milled, but the tunnel barrier is not breached. Next, the Re top electrode and Al<sub>2</sub>O<sub>3</sub> tunnel barrier are etched by an SF<sub>6</sub> RIE. We compare RA-products measured by CIPT (trilayer unprocessed) to RA-products obtained from tunnel junctions processed using our new recipe.

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