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Growth of epitaxial Al/AlOx/Re using a sputtering PLD hybrid system with *in-situ* RHEED KWANG-HWAN CHO, JACOB PODKAMINER, Department of Materials Science and Engineering, University of Wisconsin-Madison, UMESHKUMAR PATEL, ROBERT MCDERMOTT, Department of Physics, University of Wisconsin-Madison, CHANG-BEOM EOM, Department of Materials Science and Engineering, University of Wisconsin-Madison — Our objective is the growth of epitaxial dielectrics on crystalline superconducting underlayers to improve the performance of superconducting Qubits. We have grown epitaxial Re thin films on a c-plane sapphire substrate using RF magnetron sputtering, and then transferred *ex-situ* to a pulsed laser deposition (PLD) system where dielectrics thin film layer is deposited. One drawback of this fabrication approach is the necessity to expose the sample to air when the sample is transferred to different deposition chambers. In order to avoid these drawbacks, we have employed a hybrid PLD-sputtering deposition that will allow us to grow the oxide dielectric/Re heterostructures in an *in-situ* environment without breaking vacuum. The system is also equipped with reflection high energy electron diffraction (RHEED) which will allow us to perform *in-situ* characterization of the structure and growth dynamics. We will discuss our strategy of epitaxial growth of various single crystal dielectrics on superconducting thin films in this system and their structural and electrical properties of the heterostructures.

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