Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Epitaxial Growth of (111) Al/Al_2O_3/Al Trilayers on Sapphire[1]
FABIO DA SILVA, BRIAN GORMAN, MICHAEL KAUFMAN, Colorado School of Mines, HAMID FARDI, University of Colorado Denver, DAVID WISBEY, JEFFREY KLINE, NIST Boulder, DANIELLE BRAJE, MIT Lincoln Laboratories, DAVID PAPPAS, NIST Boulder — Microstructural defects in tunnel junction trilayers epitaxially grown on basal plane sapphire are observed using transmission electron microscopy techniques. The ?lms grow nominally (111) oriented with grain sizes ranging from 100 nm to 1 μm. Both twinning and low angle grain boundaries are observed in the bottom Al electrode. The rotations for the low-angle boundaries are consistent with alignment to the various $\alpha-$Al2O3 oxygen sublattice layers. The epitaxial Al2O3 tunnel barrier is approximately 1 nm thick, which is about a factor of 2 lower than necessary for use in a phase qubit, and showed defects that can be associated with the electrode grain boundaries and strain. On the other hand, grain boundaries present in the top Al electrodes were only weakly influenced by the bottom layer structure. Island formation was also observed in the Al electrodes grown on the epitaxial tunnel barriers. This is proposed to be the formation mechanism of the grain structures that is observed for the thicker top electrodes. These defects appear to be inherent to many metal/sapphire growth systems, and may limit the applicability of crystalline (111) Al on basal-plane sapphire for superconducting Josephson junctions.

[1]This work was supported by IARPA and other grants by the U.S.

Fabio da Silva
University of Colorado Denver

Date submitted: 02 Dec 2009 Electronic form version 1.4