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Growth of single-crystal Al layers on GaAs and Si substrates for microwave superconducting resonators J TOURNET, D GOSSELINK, M JAIKISSOON, WIN, Department of Electrical and Computer Engineering, G-X MIAO, IQC, Department of Electrical and Computer Engineering, D LANGENBERG, IQC, M MARIANTONI, IQC, Department of Physics and Astronomy, ZR WASILEWSKI, WIN, Deaprtment of Electrical and Computer Engineering, University of Waterloo, Canada — Thin Al layers on dielectrics are essential building blocks of circuits used in the quest for scalable quantum computing systems. While molecular beam epitaxy (MBE) has been shown to produce the highest quality Al layers, further reduction of losses in superconducting resonators fabricated from them is highly desirable. Defects at the Al-substrate interface are likely the key source of losses. Here we report on the optimization of MBE growth of Al layers on GaAs and Si substrates. Si surfaces were prepared by *in-situ* high temperature substrate annealing. For GaAs, defects typically remaining on the substrate surfaces after oxide desorption were overgrown with GaAs or GaAs/AlAs superlattice buffer layers. Such surface preparation steps were followed by cooling process to below 0C, precisely controlled to obtain targeted surface reconstructions. Deposition of 110 nm Al layers was done at subzero temperatures and monitored with RHEED at several azimuths simultaneously. The resulting layers were characterized by HRXRD, AFM and Nomarski. Single crystal, near-atomically smooth layers of Al(110) were demonstrated on GaAs(001)-2x4 surface whereas Al(111) of comparable quality was formed on Si(111)-1x1 and 7x7 surfaces.

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