Materials Science & Engineering Master's Defense

Analysis of Molybdenum-Copper Superconducting Bilayers

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abstract

A series of Molybdenum-Copper bilayers were studied for use in 120mK superconducting transition edge sensors for spectrometer applications. The Transition temperature (T_C) was tuned to the desired temperature by adjusting the thickness of the normal copper layer and the superconducting molybdenum layer in the proximitized bilayer structure. The bilayers have a fixed normal metal thickness d_{Cu} ≈1250Å, on top of a variable superconductor thickness 650Å ≤ d_{Mo}≤ 1000Å. Material characterization techniques including X-ray Diffraction (XRD), Rutherford Backscattering Spectroscopy (RBS), Atomic Force Microscopy (AFM), and 4-point electrical characterization are used to characterize the films. Film T_C are compared with the results of the Usadel proximity theory. The results of RBS analysis demonstrated that some Argon-contamination can be incorporated in Mo films, which correlated with bilayer surface roughness (as observed with AFM), reduced Mo film quality (via XRD Rocking Curve), and a deviation from the theoretical expected T_C for a bilayer. The Argon contamination is presumably the cause of interface roughness, reducing the interface transmission coefficient in the Usadel model, and producing the discrepancy from the expected T_C.

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