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Investigation of the physical properties and crystallography of Thin Film Multilayer YBa₂Cu₃O_{7-x} - NdBa₂Cu₃O_{7-x} Superconductors.

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As quantum nanotechnologies continue to advance, they require continually increasing physical properties from their thin film superconductive components, including a samples critical current density (JC) and critical temperature. This research focuses on characterising the impacts of varied layering designs, and alterations to deposition temperature, for films of less than 200 nm thickness. Monolayer and multilayered films were created using a Pulsed Laser Deposition technique, with samples magnetic and transport properties measured via a Physical Properties Measurement System, utilising the Vibrating Sample Magnometer attachment for magnetic testing, and a combination of the prototype press contact developed by our labs and the rotating sample holder both with the Electronic Transport Option attachment. The YBa₂Cu₃O_{7-x} monolayer samples displayed the best magnetic properties under all conditions, except at high temperature (77 K) under an applied field greater than 0.01 T where the pair of 5 layered films (differed by varying deposition temperatures) displayed equal or greater JC values than the monolayer sample. Whilst little difference was observed between similar samples of varied deposition temperature, the surface roughness of all samples showed layered samples with a greater amount of NdBa₂Cu₃O_{7-x} had less surface pores then samples with little or none of the compound, though such samples did have an increased amount of surface protrusions, a noteworthy result considering the importance of surface smoothness in these films applications. These protrusions crystallography, and each sample's crystal structure at large, was investigated using TEM microscopy, observing the composition of such pores and protrusions to be bulk droplets of individual (or oxides) components of the deposited compounds, usually Cu. Further analysis and comparison of each crystals strain across interfaces, crystal phases, and d-spacings were undertaken to best assess the quality and viability of each sample for practical applications, as well as the deposition process as a whole.

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