

The Multiplicative Effect of Knowledge Sharing

Kaveh Ahadi (NCSU), M.D. Williams (Clark Atlanta University), D.A. Muller and D.G. Schlom (Cornell University)

Question: What do you get when you mix the bold vision of an Assistant Professor with a thin film community open to sharing emerging know-how?

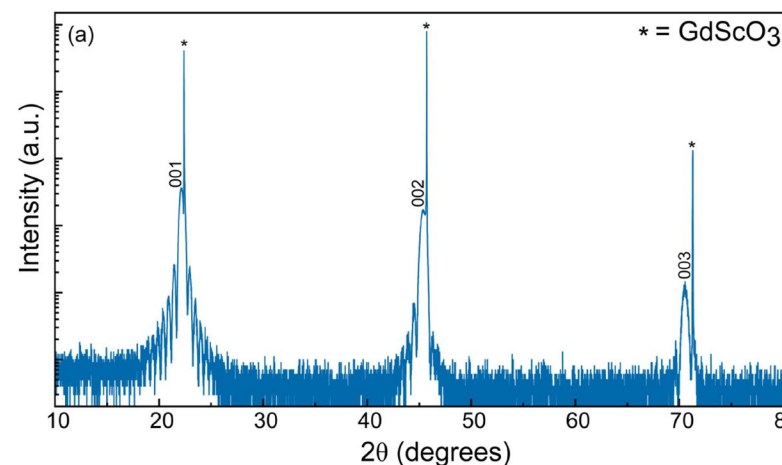
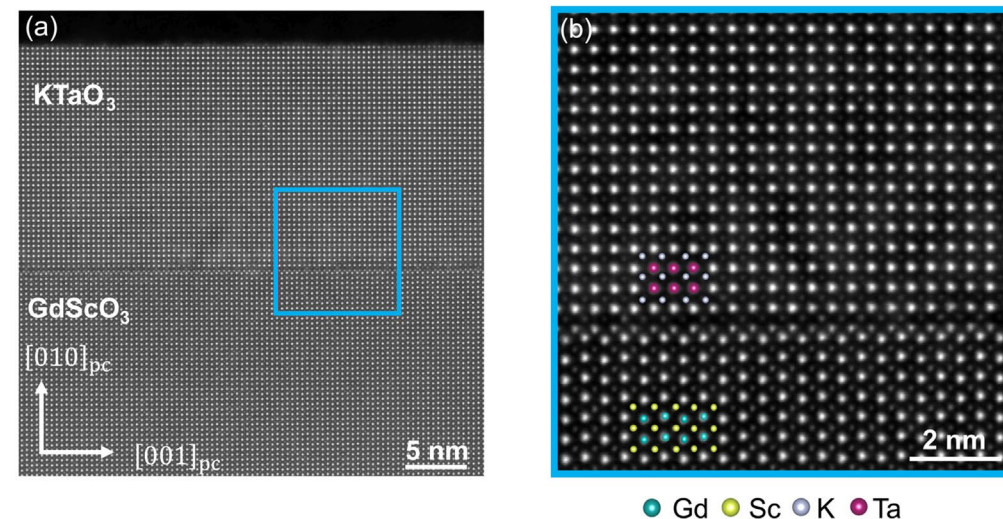
Answer: A radical collaboration that has led to the world's highest quality thin films of potassium tantalate KTaO_3 .

KTaO_3 is an incipient ferroelectric, in which superconductivity emerges at low temperatures in electron-doped samples. The KTaO_3 conduction band is derived from the Ta $5d$ states and shows highly anisotropic electronic transport. These opportunities invite the synthesis and intensive study of KTaO_3 -based thin films and heterostructures to understand and engineer these phenomena. Molecular-beam epitaxy (MBE) is an obvious method to tune the properties of KTaO_3 by producing epitaxial heterostructures where strain, juxtaposed competing orders, or other approaches to modify the ground state can be imposed, but for technical reasons KTaO_3 had never been grown by MBE.

Enter a bold user from NCSU who came to PARADIM's Thin Film Facility on a mission to grow KTaO_3 by MBE. At PARADIM, the successful growth of KTaO_3 thin films was facilitated by two innovations from other PARADIM users: **(1) suboxide MBE**, used for GeO_2 , Ga_2O_3 , SnTa_2O_6 ,... and **(2) indium-alkali metal alloys** that can be safely handled in ambient conditions and provide stable evaporation of the alkali metal as used for LiZnSb , Cs_3Sb , Na_xCoO_2 ,... plus another PARADIM user interested in definitively testing (using SIMS) whether the resulting films were contaminated with indium, which they were not.

T. Schwaigert, et al. *J. Vacuum Science & Technology A* **41**, 022703 (2023).

Data access: [10.34863/crr6-z966](https://doi.org/10.34863/crr6-z966)



(Top a, b) Atom resolution electron microscopy image of a KTaO_3 thin film and its interface with the substrate.

(Bottom) X-ray diffraction θ - 2θ scan of a high-quality KTaO_3 thin film.