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Hot Quantum Materials—Turning up the Heat to achieve Adsorption-Controlled Synthesis and Improved Perfection

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It has long been known that molecular-beam epitaxy (MBE) works best for materials that can be grown in an adsorption-controlled regime where thermodynamics automatically provides composition control. This is where MBE started—for GaAs and other compound semiconductors—and underlies its success for producing semiconductor films with the highest purity and mobility. The same holds for the growth of thin films of oxide quantum materials by MBE, but the issue has been that it has not been possible to grow that many oxides in such a regime. In this talk I will describe how high substrate temperature opens the door to this desired growth regime for the growth of thin films of oxide quantum materials. Using a powerful CO_2-laser capable of heating to substrate temperatures of 2000 °C, we have grown an increasing number of oxide quantum materials in an adsorption-controlled regime by MBE. In this talk I will show multiple examples ranging from the growth of excellent conductors ($SrMoO_3$) to incipient ferroelectrics ($SrTiO_3$) to ferroelectrics ($BaTiO_3$).

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References:

[1] A. Suceava, S. Hazra, A. Ross, I.R. Philippi, D. Sotir, D.G. Schlom, L.Q. Chen and V. Gopalan, “Colossal Cryogenic Electro-Optic Response through Metastability in Strained $BaTiO_3$ Thin Films,” submitted to *Advanced Materials*.