

Tackling Challenges in Quantum Materials with *In-Situ* Optical Spectroscopy

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Pulsed laser deposition has been a versatile tool for synthesizing and studying various quantum materials and heterostructures. However, it requires a great deal of effort particularly when dealing with competing phases. In this talk, I will discuss an *in situ* real-time monitoring technique for the synthesis of quantum material heterostructures using both optical spectroscopic ellipsometry (SE) and reflection high-energy electron diffraction (RHEED) during PLD. Optical SE is known to provide useful information on the electronic band structure of samples. However, its utility for *in situ* monitoring has been limited because of complicated spectral modeling processes. In this *dual* monitoring approach, structural information obtained from RHEED facilitates the optical SE modeling process, enabling the real-time extraction of *in situ* dielectric functions of samples. I will discuss a few challenging issues my group has been tackling in the study of quantum material heterostructures such as 1D – 2D oxide quantum stripes, oxidation/reduction dynamics, magnon dispersion, and remote epitaxy.