



**PHYSICS**  
**COLORADO STATE UNIVERSITY**



## **CSU PHYSICS COLLOQUIUM**

### **Exploiting Molecular Vibrations to Visualize Chemical Structure & Dynamics in Advanced Materials**

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#### **Abstract**

Functional devices ranging from battery technologies to photoelectrochemical technologies and beyond are heterogeneous in nature. In these systems device performance can depend on molecular interactions at solid surfaces, as well as solute-solvent interactions in bulk fluid environments. Thus, it is crucial to innovate tools with the capability to directly observe molecular structures while having sensitivity to fast solvent fluctuations such that chemical structures and solvent dynamics can ultimately be correlated to device performance. In this talk I will discuss the progress we have made towards applying nonlinear vibrational spectroscopy techniques including two-dimensional infrared (2D IR) spectroscopy and heterodyne-detected vibrational sum frequency generation (HD-VSFG) spectroscopy as tools to directly probe the molecular orientation of a classic, ruthenium-based dye at gold and TiO<sub>2</sub> nanoparticle interfaces. In addition, I will discuss enabling technologies that we have developed in the lab that open the doors to performing 2D IR microscopy in complex environments.