Dr. Jun Nishida
Center for Mesoscopic Sciences, Institute for Molecular Science, Japan

Joint Seminar: Ultrafast infrared spectroscopy at the nanoscale

Joint seminar of Fritz Haber Institute and Institute for Molecular Science, Japan

Online (Zoom)
6th September 2021, 17:00-18:00 (JST)

Emerging functional materials exhibit “liquid-like” dynamics associated with their soft lattice structures, often with spatial heterogeneity at length scales ranging from tens to hundreds of nanometers. Yet, tools to characterize such dynamical disorder have not been established. While nonlinear infrared spectroscopy has elucidated dynamics of liquids and solutions over the past decades, the limited sensitivity and the fundamental diffraction limit have hampered its applications to material systems at the nanoscale. In this talk, I will present recent advances in ultrafast infrared *nano*-spectroscopy that are now capable of characterizing ultrafast dynamics of functional materials at the nm-fs scale. We apply reflection-enhanced two-dimensional infrared (2D IR) spectroscopy to thin films of room-temperature ionic liquid (RTIL), unraveling an unusually large impact of an interface on the RTIL’s structural dynamics that propagates beyond 30 nm. We also develop highly sensitive ultrafast infrared scattering scanning near-field optical microscopy (IR *s*-SNOM) with far-from-equilibrium excitation, elucidating spatial heterogeneity in polaron dynamics in lead halide perovskites. These advances in ultrafast infrared nano-imaging and -spectroscopy provide an access to spatially disordered molecular and carrier dynamics, which directly impact device performances from batteries to photovoltaics.