

Sub-10 nm nano-gaps for terahertz spectroscopy of interfacial water**Kangwon National University and Institute of Quantum Convergence Technology¹, °Jeeyoon Jeong¹****E-mail: peterjyy@kangwon.ac.kr**

Understanding the behavior of water confined within nanoscale environments is crucial across numerous scientific disciplines, as it underpins key phenomena such as ion solvation, molecular transport, and interfacial electrochemical processes. A central focus has been the dielectric properties of nanoconfined water, especially the reduced permittivity arising from the restricted dipole reorientation of interfacial water layers. While recent advances have enabled direct measurements of static permittivity using two-dimensional material-based nanocavities and electrostatic force microscopy, insights into the high-frequency (optical) permittivity remain limited. Previous optical studies often relied on systems like nanoporous media or beryl crystals, which lack precise control over water layer thickness below 10 nm. Although ultrathin water films can be prepared under cryogenic and vacuum conditions, these are not representative of biologically relevant environments. Therefore, developing an ambient-compatible platform for systematic optical characterization of nanoconfined water remains an urgent goal for advancing both fundamental science and biomolecular applications. In this talk, we will discuss (1) fabrication of sub-10 nm metallic gaps suitable for enhancing terahertz absorption, (2) means to couple water into such gaps for sensitive terahertz spectroscopy of nanoconfined water, and (3) observation of reduced terahertz permittivity of the nanoconfined water, which is found to arise from confinement effect suppressing the long-range collective motion of water molecules, in addition to the previously well-known interfacial effect.