Magnify: Next-Generation Expansion Microscopy for Biological Model Systems and Gel-Based Nanofabrication with 20 nm Precision

Abstract:

Expansion Microscopy (ExM) is an emerging technology that enables nanoscale imaging using conventional microscopes. I will present our recently developed Magnify protocol, a next-generation ExM technique that physically and isotropically expands biological specimens without requiring a separate anchoring step. This advancement simplifies sample preparation and broadens applicability across various tissue types. Magnify can expand conventionally preserved tissues up to 11-fold, providing an effective resolution as low as 15 nm when combined with super-resolution techniques. My lab has demonstrated Magnify on a broad range of biological specimens, giving insight into nanoscopic subcellular structures, including synaptic proteins from mouse brain, podocyte foot processes in formalin-fixed paraffin-embedded human kidney, and defects in cilia and basal bodies in drug-treated human lung organoids. Additionally, I will introduce variations of the Magnify technique, such as MAGNIFIER for super-resolution vibrational imaging and microMagnify for imaging pathogens and pathogen-host interactions.

Beyond imaging, I will briefly introduce a gel-based nanofabrication approach that leverages femtosecond light sheets to pattern hydrogels as templates for assembling complex 3D nanostructures. This technique enables the fabrication of nanoscale materials with feature sizes down to 20 nm, demonstrating applications in nanodevice engineering, encrypted optical storage, and bio-integrated materials.