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Graphene liquid cells for visualization of wet samples by transmission electron microscopy at ambient temperature

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Cryo-electron microscopy enables visualization of vitrified biological molecules and molecular assemblies, but does not allow the study of water-based processes as they occur, for example, in living organisms. Fixation of liquid-based specimen between graphene allows the visualization room-temperature samples and processes in the TEM. Our group developed a high-yield method for graphene liquid cell formation on a TEM grid, enabling us to encapsulate gold nanoparticles in water as well as whole bacterial cells. The protective properties of graphene against beam damage are such that graphene-fixated sample withstand extended periods of beam exposure, allowing 3D tomography reconstructions based on an unprecedented number of slices. The most exciting promise of graphene liquid phase electron microscopy, meanwhile, lies in the atomic resolution imaging of liquid-based processes. The methods presented in this work – particularly the reproducibility and simplicity of fabrication – enable the high resolution imaging of dynamic biomolecular systems.