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Microfabricated Graphene Liquid Cells for the imaging of microtubules and protein structures using liquid phase EM

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Cryo-Electron Microscopy has produced high resolution 2D and 3D reconstructions of proteins and entire cells, yet this technique always provides a static snapshot of the system. Exciting challenges for EM now lie in expanding into the temporal dimension, where the dynamics of processes can be captured at nanoscale resolution. Liquid phase EM, where material is imaged in their native state in liquid water is therefore an exciting new avenue for research. The separation of the liquid sample from the TEM vacuum by ultrathin membranes is essential to realise high resolution and minimise electron dose. 2D materials represent the ultimate membrane material, in terms of thinness, mechanical and chemical properties. We use cleanroom microfabricated liquid sample chips for EM with graphene membranes (i.e. graphene liquid cells) to image biomolecules. Microfabrication of liquid cells yields well defined liquid volumes with large windows, enabling higher throughput than existing methods. With this setup and the unique properties of graphene we seek to answer questions about microtubules (protein filaments) and their dynamics that could up to now not be directly investigated.