

Serial single molecule electron diffraction imaging: A Journey

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Serial single molecule electron diffraction imaging (ss-EDI) relies on signal accumulation of molecules oriented in the same direction to solve the problem of crystallization in atomic structure determination of molecules and nanoclusters. A critical issue in this approach is substrate free molecular orientation. Electric field induced alignment and/or orientation relies on effective suppression of thermal rotation, thus superfluid helium droplets with an equilibrium temperature of 0.4 K offer the desired cooling effect. However, the droplet matrix also introduces a diffraction background. Here we demonstrate the practicality of electron diffraction of single molecules inside superfluid helium droplets. By taking advantage of velocity slip of a pulsed droplet beam, selective diffraction from monomers, dimers and even larger clusters can be obtained. To further extend this approach to macromolecular ions and nanoclusters, we also demonstrate doping of ions from electrospray ionization into superfluid helium droplets. Although the ultimate demonstration of ss-EDI is still steps away, steady efforts are being made toward the final goal.