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Fluctuation powder diffraction of the lipidic cubic phase: a 3D view of lattice disorder

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Fluctuation scattering methods employ the statistical analysis of large scattering datasets to obtain a more accurate structural characterization of a material. Fluctuation methods were extensively developed for electron microscopy and are also topical in coherent x-ray imaging. We have developed novel fluctuation analysis methods for powder diffraction data to exploit extra structural information in spotty or textured powder rings. Generalizing 1D pair-distribution analysis, we extract 3D real-space distributions of three- and four-atom statistics from the fluctuation powder data. We have made a proof-of-principle demonstration with lipidic cubic phase collected at the SAXS beamline at the Australian Synchrotron. We have studied the lattice disorder induced by cholesterol doping, protein uptake and lysozyme crystallization. Data was collected with the Lipidico viscous-flow syringe injector that was used at the SAXS beamline for the first time.

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