Multi-Dimensional Liquid Phase TEM for Studying Heterogeneous Catalysts

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Most of heterogeneous catalyst synthesis and their uses are developed empirically with a limited mechanistic understanding. Liquid cell TEM (LTEM) has been introduced recently for in-situ study of chemical reactions occurring in liquid. Liquid cells allow an opportunity to utilize high spatial and temporal resolution of TEM in studying reactions of colloidal nanoparticles. Achieving sub-nm spatial resolution by adjusting the thicknesses of window materials and the encapsulated liquid, important steps in growth trajectories of different types of heterogeneous catalysts have been directly observed at high-resolution of TEM. We also develop an analysis method for resolving the 3D atomic structure of individual particles in liquid. Obtained 3D density maps unveil structural features of heterogeneous catalysts that have been either underestimated or unattainable in conventional analysis.