**Supplementary Information**

**Understanding Mechanisms of Nanocrystal Formation and Transformation Via Liquid Cell TEM**

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**Figure S1** - Ex situ TEM image showing late-stage hematite spindle. (a) After 6 hours at 150°C, no akaganeite nanorods remain and the spindles are well crystallized. (b) 48 hour hematite spindle with diffraction pattern demonstrating it is single crystal.



**Movie M1** - Nucleation of Au nanoparticles.

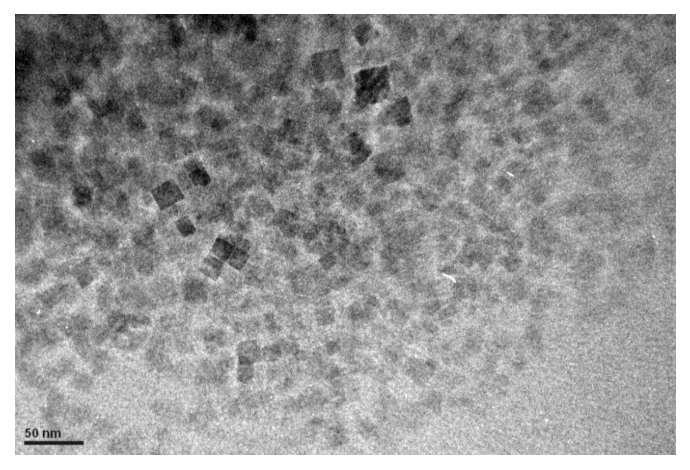
**Movie M2** - Growth of ferryhidrite by oriented attachment.



**Movie M3** - Growth of calcite by aggregation of what appear to be amorphous nanoparticles.



**Movie M4** - Diffusion and collision of calcite nanocrystals that do not appear to exhibit coalescence events. This experiment was conducted in a commercially available (Hummingbird Scientific) three port liquid flow TEM stage and compatible fluid cell.



**Movie M5** - Dendritic growth of Au nanoparticles induced by the electron beam.

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