**Beyond Crystallography:**

**"Seeing" Atoms in Real Materials**

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Modern science and technology rely on functional materials, and the physical properties of these materials often strongly depend on defects, local disorder, nanoscale heterogeneities, and grain structures at the atomic scale. Traditional crystallography, which is reliant on periodicity, has been the main method for determining crystal structures, but cannot determine defects or other non-crystalline features. My work goes beyond crystallography. Without any prior assumption of underlying structure, atomic electron tomography (AET) is now able to locate the 3D coordinates of individual atoms and their dynamics with picometer precision and with elemental specificity [1-3]. A variety of complex atomic structures have been measured with 3D atomic-level details; including grain boundaries, chemical order/disorder, phase boundaries, and point defects [1]. I will further demonstrate that AET can also be applied to capture the 4D atomic structural dynamics, unveiling nucleation process at the atomic scale [2]. Understanding the atomic resolution structural dynamics together with the relationship between atomic structure and physical properties will open up new avenues in condensed matter physics and allow the rational design of novel materials at the atomic scale [1-2].

[1] Zhou\*, Yang\* et al., Nature 570, 500 (2019).

[2] Yang et al., Nature 542, 75-79 (2017).

[3] Pryor\*, Yang\* et al., Sci. Rep. 7:10409 (2017).