

Roughening Transition in Colloidal Crystal

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20 μm

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When a crystal is heated close to the melting point, its facet surfaces and grain boundaries become rough. The roughening transition at crystal surfaces has been studied by X-ray diffraction, electron microscopy. However, the study of the grain-boundary roughening between crystals remains challenging in experiments and whether grain-boundaries have a roughening transition is not clear, the theoretical understanding is also very limited.

Here we directly visualized the roughening transition of grain boundaries at the single-particle level for the first time by using thin-film colloidal crystals. The measured static and dynamic properties such as correlation lengths and susceptibilities show that the roughening transition follows the critical behavior. Moreover, we found that large-angle and small-angle grain boundaries have qualitatively different behaviors and the capillary-wave theory is satisfied with varying cut-off lengths closely dependent on roughening transition point.