

Pre-melting of Colloidal Crystals

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20 μm

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We report the single-particle resolution experiment of pre-melting transitions at solid-vapor interfaces of colloidal crystals via video microscopy. The micrometer-sized PMMA spheres have tunable attractions which becomes stronger as temperature increases. We found that pre-melting and melting behaviors are substantially influenced by dimensionality. In thin-film samples, the thickness of liquid interfacial layer diverges in 'power-law' and the melting starts from interfaces, consistent with the pre-melting theory for three-dimensional crystals; while in monolayer samples, the thickness of liquid layer does not change with temperature and the melting starts from within the crystal through the formation of grain boundaries. The temperature dependence of the wetting effect, the particle dynamics and the mechanical stability of the crystals are measured in both cases. These observations may evoke refinement of pre-melting theories in thin films and two dimensions.