Quasi-planar nucleus structure in apoferritin crystallisation

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The structure of the nucleus largely determines the thermodynamics and kinetics of first-order phase transitions . A compact three-dimensional arrangement of the molecules in the nucleus has often been assumed . Recent molecular dynamics simulations predict a compact nucleus structure for atoms or molecules with a spherical interaction field , while strongly anisotropic, dipolar molecules may bear nuclei consisting of a single chain of molecules . Here, using atomic force microscopy (AFM) *in situ* during the crystallisation of the protein apoferritin, we image the arrangement of the molecules in near-critical clusters, larger or smaller than the crystal nucleus, that are representative of its structure. In the supersaturation $\Delta m/k_B T$ range of 1.1–1.6, the nuclei contain 50–20 molecules. Within the nuclei, the molecules are arranged as in a large crystal. Contrary to the general belief, the nuclei are not compact molecular assemblies, but are planar arrays of about 5-10 rods of 5-7 molecules set in one or two monomolecular layers. Similarly unexpected nuclei structures might be common, especially for anisotropic molecules. Hence, the nucleus structure should be considered as a variable by advanced theoretical treatments.