Observing Classical Nucleation Theory at work: Monitoring phase transitions with molecular precision

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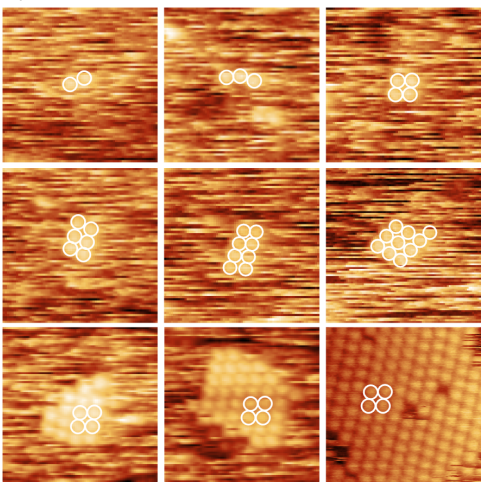
It has become widely accepted that many phase transitions do not follow nucleation pathways as envisaged by the Classical Nucleation Theory. Many substances can traverse intermediate states before arriving at the stable phase. The apparent ubiquity of multi-step nucleation has made the inverse question relevant: does multistep nucleation always dominate single-step pathways? Here we provide an explicit example of the classical nucleation mechanism for a system known to exhibit the characteristics of multi-step nucleation. Molecular resolution atomic force microscopy imaging of the two-dimensional nucleation of glucose isomerase demonstrates that the interior of subcritical clusters is in the same state as the crystalline bulk phase. Our data show that despite having all the characteristics typically associated with rich phase behavior, glucose isomerase 2D crystals are formed entirely classically.



These observations illustrate the resurfacing importance of the classical nucleation theory by re-validating some of the key assumptions that have been recently questioned.