Atomic Behaviors of Quantum Dots and NaCl Crystal Nucleus Revealed by Single-Molecule Analyses

(*Department of Chemistry, The University of Tokyo*) ○Takayuki Nakamuro, Olivier Chevalier, Masaya Sakakibara, Shang Rui, Eiichi Nakamura
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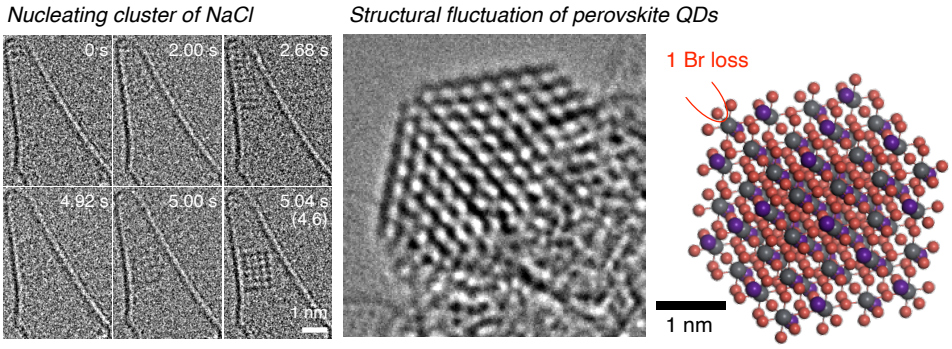
The acquisition of structural information is of paramount importance in nanostructured materials such as quantum dots (QDs) since the structure of the material is directly related to its optical and material properties. We have developed a method to utilize the inner space of carbon nanotubes (CNTs) as the nano-observation fields, and a method to chemically modify molecules on CNTs surface for single-molecule atomic-resolution time-resolved electron microscopic (SMART-EM) observations. In this study, we report on SMART-EM observations of crystal nuclei, which consist of tens to hundreds of atoms, to reveal their dynamic behaviors.

The fluctuation of nucleating clusters in nucleation was analyzed in detail by using NaCl as a model and observing the crystallization phenomenon continuously for 152 seconds.[1] SMART-EM observations have revealed features of NaCl nucleating clusters fluctuating between disordered and ordered structures, and a similar result has been reported for the nucleation process of gold.[2] A newly synthesized blue light-emitting perovskite QDs that emits at 463 nm with quantitative photoluminescence quantum yield show only one bromine defect at the corner Pb atom and no defect at the edges of the cubic structure, as suggested by the chemical composition derived from the SEM-EDX analysis and optical properties. We also detected the dynamic structural fluctuation of QDs through SMART-EM observations.



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