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Molecular technology for atomic-level precise artificial atom

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As the future nanotechnology, atomic-level manufacturing is vital in various research fields including the next generation electronics and energy-related devices. Simultaneously, we need to consider our sustainable development: The limitation of elemental resources, impacts on the environment, material safety, and stability. Herein, we functionalize oxides based on a concept of artificial atom through atomic-level control of the structure because oxygen is the most abundant element existing as oxides on the earth. Additionally, artificial atom has attracted much attention to create artificial materials unlimited by the atomic properties and to develop single-electron electronics based on Coulomb blockade. To obtain an ideal artificial atom at room temperature (RT), the tiny dots need to be less than 2 nm in size so that the charging energy of each single electron exceeds the thermal energy at RT. Besides, reorganization of the surroundings dominates electron transfer in molecular scale as described by Marcus theory, which is totally different with electron tunneling adopted in nano scale. Therefore, we first established a method to deposit molecular-scale oxide dots on substrates based on the number of metal ions contained in super-molecular assembling precursor; oxide is beneficial to obtain atomic-level precise structures due to the strong binding energy of ionic covalent bond. Next, we seamlessly covered the surroundings with atomic layer deposition oxides. In the molecular technologies, the chemical design of precursors and chemoselective multistep processes like multistep total synthesis in organic chemistry make it possible to oxide-based complex structures with atomic-level precision.

Biography

Norifusa Satoh received his Ph.D. from Keio University with honors in 2006. After serving as a postdoctoral researcher and an Assistant Professor at Keio University, he moved to National Institute for Materials Science (NIMS) as a permanent staff researcher in 2009. During 2011-2013, he was a visiting scientist at Harvard University. Through his wide range of experiences manipulating atoms and electrons in molecular chemistry, he aims to apply the fundamental concepts to oxide-based materials and electronics.

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