

Through Quantum Dot to Quantum Crystal: Creation and Development of 2D, 3D Nanoparticle Crystal

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【 Outline of survey 】

Nanometer-sized metallic or semiconductor solids (quantum dots) are produced by a wet chemical method in a beaker likewise in a case of organic synthesis and a new technique is now developing as for crystallization of quantum dots (quantum crystal) by a self-assembling method in a solution.

The arrangement of size- and shape-controlled quantum dots of metals and semiconductors is a one of most important object of nanotechnology. That is to say the realization of artificial crystal of nano-sized particles regarding as atoms is a target for many leading groups in the world. There are a few groups that aim production of hydrosol in the size range of nanometer and arrangement of quantum crystals. We have reported for the first time the success of 2D and 3D superlattices in water phase made of mercaptosuccinic acid modified gold nanoparticles three year ago. Since then, we have developed the preparation of nanoparticle crystals of silver and silicon as well as gold in the size range from 1 to 10 nanometer, in which we can expect strong quantum size effect revealing various electronic structures different from bulk metals and semiconductors.

【 Expected results 】

A quantum crystal we have prepared is not a normal crystal in which atoms and ions are building units but consists of nanoparticles whose electronic state is in the quantum size effect regime, to which we can design by choosing the size and shape of particles. Therefore, it is expected that a new kind materials supplied from our project will be a key crystals useful in the engineering object. The strategy for the designing of electronic state of quantum crystals and for the mass production technique of quantum dots in wet chemistry will be opened for the public use.

【 References by the principal researcher 】

- 1) The First Example of Ordered Two-Dimensional Self-Assembly of Au Nanoparticles from Stable Hydrosol; S.Zhao, S.Wang and K.Kimura; Langmuir 20(2004)1977-1979
- 2) Preparation of Hexagonal Closed-Packed Colloidal Crystals of Hydrophilic Monodisperse Gold Nanoparticles in Bulk Aqueous Solution, S.Wang, S.Sato and K.Kimura; Chem.Materials, 15(12) (2003) 2445-2448

【 Term of project 】 F Y 2004 - 2008

【 Budget allocation 】 85,100,000 yen

【 Homepage address 】