Worldwide R&D

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A crystal is a solid having a regular arrangement of atoms and molecules. By creating crystals with a desired quality, it is possible to achieve high purity that can be kept stable for a long period of time and that can be freely controlled with complex functions. Hence, we are striving to develop an environmental friendly crystalline product of a desired quality as a 21st century material for biotechnological and environmental use. To make crystals in a solution (known as crystallization), the concentration of the solution is made higher than their solubility (supersaturated state) to produce seeds of a crystal (crystal nuclei). These seeds are grown to cultivate large crystals. By controlling the number of seeds and their growth rate during this process, it is possible to control the size, shape and structure of the crystals. We have witnessed the instant at which molecules and atoms in the solution become crystals. The solution begins to quiver and the crystals are born among the oscillations. While crystals are inanimate, they appear like living organisms that are born as seeds and grow as if they are alive.

Today we are conducting research for producing desired crystalline products while attempting to better understand basic crystallization phenomena. We have organized projects on pharmaceuticals and organic crystals, nano-crystals, environment and recycling, and heat storage (storing heat in the form of crystals). Topics of our research are discussed in greater detail below.

Environment and recycling

We are constructing processes that are capable of not only removing but also recovering substances that have adverse affects on the environment, including such nutrients as nitrogen and phosphorous and such industrial emissions as fluorine and metal ions. In collaboration with industry and academia, we are advancing R&D aimed at establishing optimal operations and processes for the removal and recovery of these targeted substances in the form of crystals. The resulting process for removing and recovering fluorine and phosphate ions is being implemented with full-scale equipment and is contributing to the recovery of unused resources. While fine crystals tend to be generated in the crystallization process, we have obtained coarse spherical crystals by efficiently conducting supersaturation formation, attachment of fine crystals, and agglomeration. Further, through collaboration with other companies, we have conducted successful research on recovering nickel ions in the form of nickel metal (more than 99% pure) from a used bath of electroless nickel plating in the presence of a reducing agent. We believe that this research will help in the recovery of other rare metals and the creation of nano-size metals.

Creation of Nano-Crystals

Crystals in the nano-size (10^{-9} m) range have a large surface area per gram and exhibit functions that are not seen in larger crystals. We are trying to produce a crystal of this size in a highly supersaturated region. In order to produce functional crystals (such as those that emit blue or red fluorescence or those with a confined distribution of nano-size particles), we are attempting to produce nano-size crystals, focusing on crystallization with polyelectrolytes (see photo), controlling nucleation with the presence of heterogeneous crystals, and nucleation induced by ultrasonic waves.

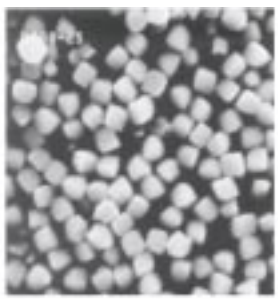
Pharmaceuticals and Organic Crystal Control

Many crystalline products in pharmaceuticals are hydrophobic and, hence, cannot be dissolved or absorbed in the human body efficiently. Accordingly, it is important to obtain crystals having a desirable solubility and nano-size crystals. We are conducting research aimed at creating such crystals.

Heat Storage Process

Latent heat storage is a method for storing heat in the form of crystals. Our laboratory is working to recover waste heat of various temperatures using hydrated salt crystals. Joint research is being conducted with other companies on ice storage, and a new heat storage system is currently operating at the Minato Mirai 21 District Heating and Cooling Service Co., Ltd. located in Minato Mirai 21 district, Yokohama. Our know-how for creating crystals is thus applied in the effective use of thermal energy.

http://www.sci.waseda.ac.jp/research/



Nano-size lead sulfate produced through reaction crystallization in a polyelectrolyte environment

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