Reasons to be a Solid State Scientist

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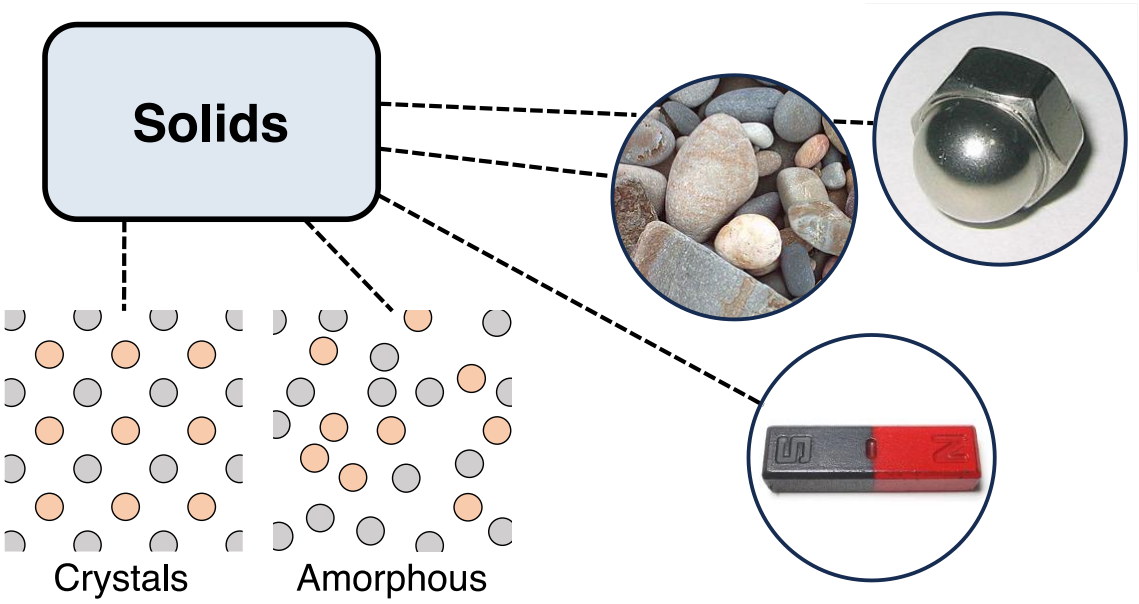

1. Introduction of Solid State Chemistry

My specialty is solid state chemistry. As the name suggests, solid state chemistry is the study of solids in general, with the following ultimate two goals.

1) To elucidate the relationship between the chemical state and properties of solid.

2) To make it possible to freely synthesize solids in various states.

One attempt to achieve 1 is, for example, band theory. This is a theory that attempts to understand the behavior of electrons in solids using the concept of energy bands. Electrons are known to be deeply involved in electrical and thermal conduction in solids, and through band theory we can understand these properties of solids. For 2, for example, vapor deposition technology is an example. Imagine leaving frozen oranges on a humid day. Water vapor in the air naturally collects on the surface of the

frozen oranges, condenses, and eventually turns into ice. By applying this phenomenon, it is possible to produce a very high purity solid. For example, high-purity silicon wafers for semiconductors made by vapor deposition technology have a purity of 99.9999% or higher.

The term solid covers a wide range of areas, and there are various ways to approach the subject. For example, in the field of solid state crystallography, crystals (solids, of course), which are made up of atoms arranged in ordered rows, are the subject of experiments. Basically, the various properties that derive from orderliness are of interest, and this is a highly sensitive study in which small changes in the orderly rules can have a large impact. On the other hand, there is solid state chemistry, which studies "amorphous" solids. Amorphous is a solid made up of atoms and molecules arranged in an unordered manner. For example, glass is amorphous and has no orders, so the researches proceeds with a very rough view of things.

Thus, solid state chemistry has many different ways of proceeding, and at times appears to be almost a different science. However, I believe that they all aim for the same thing and will converge in the end to the aforementioned goals.

2. What Inspired me to Solid State Chemistry

When I was a little, I was the kind of kid who would bring home rocks and get scolded by my parents. Roadside rocks and rock walls, concrete, steel, and plastics used to make buildings had a unique charm, and their fragments were treasures. This trend hasn't changed even as I have gotten older, and I still get emotional when I look at concrete walls. I'm an adult now, so I don't scrape off them and take it home. In other

words, I like these "solids", and often want to know more about them. Solid state chemistry is a science that examines solid, allowing me to examine and learn in detail what the beautiful objects in front of me are like.

3. The Expected Impact of Solid State Chemistry

The world is full of solid. Most of the materials we can see are solids and solids are still the mainstream of tools produced by humans, from stone axes to semiconductors. Theoretically, solid state chemistry is interested in all of these solids. Research results are often involved in the development of such tools or materials, therefore the potential impact of its research is therefore wide-ranging.

One of the noteworthy studies conducted in solid state chemistry is superconductivity. Superconductivity is a phenomenon in which the electrical resistance of an object becomes completely 0 under certain conditions, which is currently only observed in solids that are extremely cooled or pressurized. This phenomenon have become a subject of interest in various fields due to its practical and special properties, and solid state chemistry belongs to the experimental part. In recent years, materials have been discovered that cannot be explained by the principle of superconductivity as previously thought[1], and this could significantly change mankind's understanding of superconductivity in the future.

Direct social contributions can also be expected. For example, the laboratory which I belong to is conducting research on all solid state batteries. This is the battery that the liquid electrolytes used in existing batteries with a solid one, and is expected to help miniaturize the battery by increasing its density and fundamentally solve leakage

accident. It is still fresh that Toyota has made a full-scale entry into the solid state battery in recent years, and common sense about batteries may change completely in the next 10-20 years.

Thus, solid state chemistry is an active research field in many different areas. Although the goals discussed at the beginning are still far away, steady progress is expected in the future.

4. Referenses

[1] Y. Kamiyama, T. Watanabe, M. Hirano, and H. Hosono, *J. Am. Chem. Soc.* **2008**, 130, 3296

・All photos used in the figure are taken from the following Wikipedia pages.

https://ja.wikipedia.org/wiki/石

https://ja.wikipedia.org/wiki/ナット

https://ja.wikipedia.org/wiki/磁石

5. Tools

・DeepL translation was used to make English sentences sophisticated.