Remarks on Special Issue on Materials Characterization Research

Shunichi HAYASHI
Executive Officer, Head of Laboratories, Dr. Eng.
Advanced Technology Research Laboratories

Research and development is expected to elicit proposals of technologies that eliminate reworking and support speed in mass production industries such as the steel manufacturing industry. To this end, it is important to understand principles intrinsic to a new product and new manufacturing process. Recently, analytical technologies are being recognized as indispensable tools to obtain important information on the functional development and structural refinement of a material. Now, we are in an era in which new products cannot be developed without such information.

My senior colleagues told me that both seeing and measuring are the starting points of science. In my opinion, the essence of analytical science is seeing what is hidden and seeing things as they are. Adding a trace constituent may make a drastic change to the macroscopic characteristics of a material. However, there is still a lack of information available to us regarding manufacturing processes, unless the behavior of the added element and the expression for the macroscopic characteristics significantly changed by the behavior are clarified.

I think seeing what has been invisible sheds strong light on the development of materials and processes and helps us to understand the chemical state in which the specific element in question exists, which allows us to identify the significant contribution the element makes to the observed macroscopic physical properties. In analytical chemistry, speciation analysis to observe things as they are (technology to analyze chemical states) is becoming increasingly important.

Using the Internet of Things (IoT) and artificial intelligence (AI) is useful to optimize a manufacturing process. Meanwhile, many sensing technologies should have been supported in obtaining big data.

Sensing is believing.

Mathematical approaches are taken to solve chemical reactions in a blast furnace by using an inverse problem analysis. Combining the inverse problem analysis applied for the big data obtained with learning using AI gradually renders a black box transparent.

Analytical science, together with the technologies for seeing, is entering a new stage to consider how big data is to be handled and interpreted. The analytical technologies themselves are said to consist of the most advanced technologies of the day.

Developing and fully using such analytical technologies in the pursuit of new principles to create and provide new products are the missions of Nippon Steel & Sumitomo Metal Corporation and its Advanced Technology Research Laboratories.

Along with the possible continuous progress that analytical technologies can make driven by our daily efforts, the sense of expectancy of materials characterization research in the contribution to the development of materials and processes will likely grow.