Aiming at a Breakthrough

The world supported by the Thin Film and Surface Physics

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The Thin Film and Surface Physics Division was established in February 1970, after five years of research activities aimed at combining surface science and thin film technology, as surface research was gradually establishing a position as an exact science amid the evolution of all draw high vacuum technologies. The Division had about 300 members at the time of its inauguration, but it currently has approximately 900 members. Japan Society of Applied Physics meetings are divided up into different sessions, such as ferroelectric film, carbon based thin film, oxide electronics, new thin film materials, surface physics/vacuum, and probe microscopes, but the members' specialties include a wide range of fields, ranging from semiconductor and superconductor nanotechnologies to the development of organic and biomaterials, so this Division holds a core position in the context of JSAP.

Film technologies offer outstanding old characteristics versatility, and so have become the foundation for many fields targeting the development of new devices and functional materials. These technologies have come to play a vital role in this regard. The recent development of flat or "thin" screen TVs has established the concept of "thin" as a common aspect of our daily lives, and we are already seeing products such as displays and solar cells that are not only thin and light, but can also be bent and shaped. Astounding new functions integrated into surprisingly thin devices are an appointment of the scientific and technological innovations recently been achieved in the nano-scale world, and give us a sense of the further developments being achieved based on thin film technologies.

Along with thin film technologies, surface science represent the second key factor that supports the development of new materials and functional elements. As mentioned above, new research is being undertaken aimed at developing technologies for producing clean surfaces under ultra-high vacuum conditions and for conducting detailed evaluations of the various phenomena that arise during those processes. The invention of "scanning tunneling microscopes" by Dr. Gerd Binnig and Dr. Heinrich Rohrer of IBM Zurich, both recipients of the Nobel Prize for Physics in 1986, made it possible not only to observe the structures of solid surfaces and phenomenon occurring at the atomic level on those surfaces, but also to freely manipulate individual atoms and molecules. As the saying goes, "A picture is worth a thousand words." ; this new device revealed the atomic and molecular structures and dynamics of surfaces that could only be imagined in the past, clarifying many local hidden phenomena that never appeared through existing technologies dealing only in averaged information.

In 2007, Dr. Gerhard Ertl of the Fritz Haber Institute received the Nobel Prize in Chemistry for "studies of chemical processes on solid surfaces." He was recognized for having established methods using surface science technologies for accurately investigating the mechanisms of typical catalytic reactions, such as the synthesis of ammonia on iron surfaces or the oxidation of carbon monoxide on platinum surfaces, and for cultivating surface sciences into a major research field. His research that made it possible to see the reaction in which carbon monoxide changes into carbon dioxide on a platinum surface showed the dynamics of chemical reactions as a beautiful image that was startling and impressive to all that saw it.

In 1991, to mark the 20^{th} anniversary of its inauguration, the Thin Film and Surface Physics Division established the "International Conference on Atomically Controlled Surfaces, Interfaces and Nanostructures (ACSIN)," which is held in turns in Japan, the U.S., and Europe, and which leads and supports all of these fields. (The 9^{th} Conference was held in Japan in 2007.) For the past 15 years or so, I have been involved in the development of methods focusing on "Scanning probe microscopes" and in research on nano-scale physical characteristics. Looking at the path of development, from the early stages when such great effort was required to see atoms to today, when it is possible to freely manipulate individual atoms, I realize that this path represents the history of fields covered by ACSIN, and I am strongly reminded of the important role played by the Thin Film and Surface Physics Division.

We often hear that "surfaces are extremely thin, but they do have a thickness." The evolution of modern nano-scale science and technology is expected to remove the barriers between many fields, and to enable the merging of different fields and the creation of new fields. As I have stated, it is no exaggeration to say that the world of surfaces and thin films, demonstrating thickness and depth, will be the central stage for those activities. Existing semiconductor technologies have reached a limit in terms of sizes, where the smallest attainable devices measures several tens of nanometers, and there is a strong demand for new ideas and dramatic leaps forward in new technologies that will enable new functions to be achieved. Further innovations will also be required to effectively utilize the diverse characteristics of molecules. I have great expectations that the evolution of thin film and surface physics will open up new worlds, making major contributions to the development of new sciences and technologies that transcend existing fields, and triggering new and important breakthroughs in the future.

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