Education and Research Areas in the Doctoral Course

Department of Materials Science and Production Engineering

In this program, we examine materials as basic functional elements constituting contemporary society. We conduct research and carry out educational activities to gain an understanding of the functions of materials and development of production techniques, as well as technology for the generation and processing of the various types of data associated with these materials.

Progress in science and technology to date has been sustained by the discovery of new materials and the development of better techniques for their production. The identification and efficient production of materials with novel applications has led to the generation of new technologies that enable mass production and fueling advancements in industry. The demand for materials for use in frontier technology fields has been intensifying in recent years. As a result, creative production techniques that use ideas and approaches different from those employed to date need to be developed. Henceforth, rather than treating each stage of the development process separately, we must create systems that incorporate all stages, from the design of materials with new functions, through manufacturing technology to realize these functions, to production processes that make high-quality mass production possible. Education and research in this Division addresses these issues in relation to the development of new materials, production techniques, and systematization.

The three major courses in the Department of Materials Science and Production Engineering are as follows.

○ Intelligent Materials

In this course, students will study the synthesis and identification of functional properties of high-functionality materials that hold the key to future technological innovation. This includes the realization of advanced functionality for existing inorganic, organic, and macromolecular materials, and combinations thereof, the synthesis, design, and evaluation of new ceramics, magnetic materials, and other new substances, as well as energy conversion materials and the relationships between the structure and function of these materials. This includes the construction, design, and evaluation of biological and biomimetic materials.

○ Mechanical Engineering

In this course, we study a broad range of topics in mechanical engineering, a field that has become the indispensable backbone of Japan's creative and craftsmanship-inspired industries, with emphasis on the following four core disciplines: strength of materials; dynamics of machinery; fluid dynamics; and thermodynamics. In this course, to meet the needs of the industrial business world, we aim to nurture highly-skilled and highly-adaptable technical experts.

○ **Electrical and Electronic Systems**

In this course, we study the fields of electricity, energy, electronics, information and communications, and electronic device materials, which are all vital disciplines for the future development of our advanced information-based society. Topics covered include leading-edge developments in magnetic materials, dielectric materials development, efficient energy generation, transportation and storage development, plasma discharge measurement and control, superconductivity applications for energy storage, high-temperature heat transfer and its control in combustion and thermal flow, high-speed optical communications, and semiconductor materials development and evaluation. Research in these fields involves complex systems comprised of nonlinear elements, and as such in this course we will also study the fundamental mathematical sciences of nonlinear system measurement, analysis and control.