Foreword

Prospects for a Hydrogen Energy Based Society

NAKAMURA Hiroshi

Corporate Officer
Chief Technology Officer
R&D Division General Manager
HORIBA, Ltd.
Doctor of Engineering

The spread of the new coronavirus caused a slowdown in economic activity in many countries around the world, with real GDP growth of -6.3% in 2020, the largest drop since World War II. However, as a response to the crisis, many countries have decided to adopt environmentally sustainable economic measures. The European Union launched its "Green Recovery" measures and announced the "European Green Deal," with the goal of halving greenhouse gas emissions by 2030 and reducing them to virtually zero by 2050. The establishment of the European Recovery Fund was also announced, attracting attention as a fund to support environmentally friendly policies. The U.S. also announced environmentally friendly policies under the Biden administration and announced at the G7 Summit that it would halve its greenhouse gas emissions by 2030.

The European Commission has published a "European Hydrogen Strategy for Climate Neutrality", which states that "green hydrogen", hydrogen produced from renewable energy sources as primary energy, is essential to achieving "carbon neutrality" in 2050. This strategy set a goal of installing at least 6 GW of hydrogen production facilities using water electrolysis by 2024 and 40 GW by 2030. Germany and France have also developed national strategies and plan to invest heavily in hydrogen production, aiming to have 5 GW and 6.5 GW of hydrogen production capacity by 2030, respectively.

The Haber-Bosch process, developed in the early 1900s, made possible the mass production of chemical fertilizers by producing ammonia from nitrogen and hydrogen, which has supported the rapid increase in population since the 20th century. Even today, hydrogen is widely used for petroleum refining and petrochemical products, in addition to ammonia production. However, as of 2020, 95% of the hydrogen used in industry will be so-called "gray hydrogen," produced by steam reforming of fossil fuels, which emits CO_2 during production.

In order to achieve carbon neutrality, hydrogen is once again attracting attention as "green hydrogen," which is produced from renewable energy sources such as

solar and wind power generation, where the unstable power supply is an issue. In addition to conventional industrial applications, hydrogen can be used as fuel for fuel cell vehicles, hydrogen reduction in steelmaking, hydrogen engines that burn hydrogen directly, and gas turbine power generation after conversion to ammonia which is easy to transport.

HORIBA's founding product, the pH meter is based on electrochemical reactions, which are indispensable for the utilization of hydrogen and the catalyst technology. This technology which is indispensable for the realization of a carbon neutral society, was learned from Germany in the early 1900s by the founder Masao Horiba's father, Nobukichi Horiba, a researcher at Kyoto University. He supported the development of chemical engineering in Japan. It can be said that the research and technology that Horiba was involved in at the time of its founding and even before that have led to the company's current efforts to address social issues such as the utilization of hydrogen. Since the late 1990s, we have also been developing technologies for the direct measurement of hydrogen and moisture, and for the measurement of fuel reforming gas and hydrogen combustion gas for the development of fuel cell vehicles, which were booming in the automotive industry. In 2018, we acquired HORIBA FuelCon (HFC), located in Sachsen-Anhalt, Germany, expanding our portfolio to include evaluation equipment, manufacturing equipment, and production quality inspection equipment for fuel cell and water electrolysis research and development. In January 2023, HFC started operation of a new plant "eHUB" (Figure 1), which has tripled its production capacity to meet the rapidly growing demand for manufacturing and evaluation equipment for water electrolysis systems in Europe.

Hydrogen has a very high energy density per unit mass compared to other energy sources. To obtain the same energy as 1 L of liquid gasoline, about 3,000 L of gaseous hydrogen is required, which converted to mass is 270 g of hydrogen for 750 g of gasoline. Incidentally, to store this energy in today's lithium-ion batteries would require 100 times that amount, about 27 kg of mass. In comparison, hydrogen has a very high energy density per unit mass, and thus has potential as a source of energy for mobility and as a means of energy transportation, where mass is an important factor. On the other hand, there are a wide range of technical issues that need to be addressed in order to make it commercially viable, such as its difficult handling due to its gaseous state in the standard state, and its low efficiency when converted to other forms of energy such as electricity, heat, or e-fuel.

HORIBA hopes to contribute to the realization of a carbon neutral society by applying its analysis and measurement technologies to the search for new materials for fuel cells and water electrolyzers, the development of hydrogen combustion technology, and the development of catalysts for the efficient production of synthetic fuels from hydrogen and CO_2.

Figure 1 Exterior of new facility "HORIBA eHUB".

* Editorial note: This content in based on HORIBA's investigation at the year of issue unless otherwise stated.