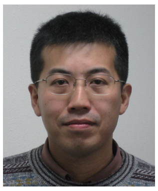
Faculty of Engineering
Thermofluid Physics Laboratory

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▶http://www.mech.kyushu-u.ac.jp/˜heat/

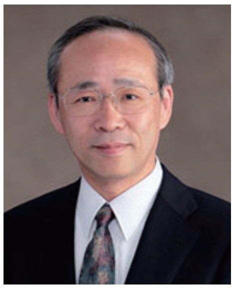
Thermophysical Properties of Hydrogen

Accurate thermophysical properties of hydrogen are essential to provide reliable designs in the coming hydrogen society. PVT property, viscosity and thermal conductivity are measured in the temperature range from -40 °C to 500 °C and at pressures up to 100 MPa. Based on the measured data, an equation of state and correlation equations are developed. They are compiled in a thermophysical property database, by which the thermophysical properties at any conditions are easily obtained.

Measurement Apparatus for High-Pressure Hydrogen

The apparatus is originally designed and developed with remote control system to achieve accurate measurement of thermophysical properties of hydrogen at extremely high pressures up to 100 MPa. The PVT property is measured by a magnetic suspension densimeter. A vibrating wire viscometer is used for the viscosity measurements, and the thermal conductivity is measured by the transient short hot-wire method.

Measurement apparatus of hydrogen thermophysical properties
(A) Magnetic suspension densimeter
(B) Vibrating wire viscometer
(C) Thermal conductivity apparatus by transient short hot-wire method



Faculty of Engineering
Hydrogen Storage Systems Lab.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Highly efficient and safe hydrogen storage and transportation

After the energy paradigm shift occurred because of the earthquake on March 11th 2011, energy storage, especially that of fluctuated renewable energy attracts much attention than before as well as mobile applications such as on board hydrogen storage for fuel cell vehicle.

Hydrogen is gas at ambient temperature and pressure. The volume energy density of hydrogen gas is only 1/3000 of gasoline, therefore, to store and transport hydrogen in a limited space is a critical issue to be solved before to realize the hydrogen economy. Hydrogen storage materials provide compact, energy efficient, safe and affordable method of hydrogen storage and transport). Our Laboratory investigates hydrogen storage materials and develops novel materials those are indispensable to realize the hydrogen economy based on fundamental studies.

The first fuel cell vehicle from TOYOTA that stores hydrogen using the material developed by Prof. Akiba and Dr. Iba (TOYOTA) in 1996.

Faculty of Engineering
Solid Mechanics Lab.


Hiroshi NOGUCHI
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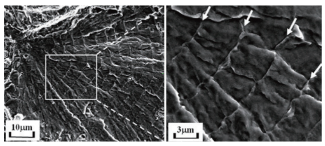
Hydrogen Effect against Strength Reliability of Materials

In order to use engineering structures safely in hydrogen environment for a long time, hydrogen effect evaluation which affects mechanical strength is one of the most important issues. A carbon steel and a low alloy steel are very promising material in economic point of view used in hydrogen environment. In order to use inexpensive material reasonably, it is necessary to clarify fracture mechanism of the materials. Therefore, the fatigue behavior of the low carbon steel has been investigated in hydrogen environment.

● Fatigue crack growth mechanism clarification and its application in hydrogen environment

A purpose of this study is to establish the reasonable method that evaluates fatigue crack growth mechanism with fracture morphology in hydrogen environment. From the results, it is now possible for the frequency dependency to evaluate reasonably, which is very important consideration in hydrogen environment.



Brittle striation morphologies that appeared on hydrogen environmental fatigue fracture surface

● Hydrogen effect investigation on a small fatigue crack behavior

A study on a small fatigue crack that spends most life time in total fatigue life has been performed in hydrogen environment. In this study, the condition which use safely in hydrogen environment has found through the small crack growth and fracture morphology analysis.