

New Technology for Carbon Neutral Energy

Tatsumi Ishihara

*^aInternational Institute for Carbon Neutral Energy Research,
Kyushu University, Motoooka 744, Nishi-ku, Fukuoka, 819-0395, Japan*

* ishihara@cstf.kyushu-u.ac.jp

Keywords: Photocatalyst, Steam electrolyzer, solid oxide reversible cell

At present, climate change is the most serious issues in development of human society and development of low carbon society is strongly required. On the other hand, energy cost gradually increases in the last decay and so more environment compatible as well as highly efficient energy generator is demanded. From these point of view, several carbon neutral energy technologies will be introduced in this talk.

As a renewable energy, solar and wind energy are strongly expected, however, because of fluctuated and low power density, averaging and concentrating electric power is an important for these renewable energy. For this, converting to H₂ as an energy carrier is more promising than storage in battery. Photocatalyst for water splitting can directly convert the solar energy to hydrogen. There are several catalysts proposed as photocatalyst for water splitting, however, visible light was not effectively used for water splitting up to now. In this talk, modification effects of inorganic semiconductor with organic dye will be introduced. In this catalyst, two excitation by photon at two difference frequency is used and achieved the so-called Z-scheme excitation. Figure 1 shows image of the dye modified GaN(ZnO) and H₂, O₂ formation rate in water splitting as a function of wave length of light. This catalyst exhibited high activity to water splitting and H₂ and O₂ formation rate of 59.1 and 21.1 mmol/h g_{-cat} achieved, respectively under 420 nm light irradiation. On the other hand, low temperature steam electrolysis is another important system for H₂ production with high efficiency. For this technology, by using heat, required electricity became smaller comparing with the normal electrolysis. In this presentation, introduction of steam electrolysis is introduced for solar hydrogen system.

By using LaGaO₃ fast oxide ion conductor, high efficiency of electrolysis was achieved and thermal neutral current of 400 mA/cm² was achieved at 1073 K when Ni-Fe/La(Sr)Fe(Mn)O₃ composite fuel electrode. On the other hand, this cell is also suitable for reversible operation and in SOFC mode, the maximum power density was as high as 0.6W/cm² at 1073 K. Therefore, combination of solar cell with steam electrolyzer gives the highly efficiency solar production system and converting electricity by reversible operation of SOEC is also promising process for carbon neutral energy.

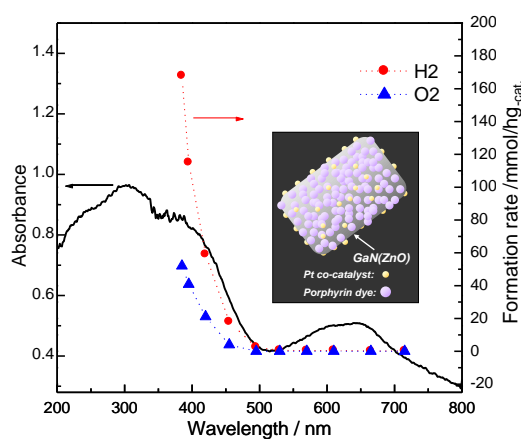


Fig.1 Water splitting activity of RhO_x, NiO / Alizarin yellow R / IrO₂-GaN:ZnO catalyst