1P030

He 誘起ナノ構造の SRM 触媒への応用

Application of He-induced nanostructures to SRM catalyst

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1、Background and purpose

In recent years, the shortage of fossil fuels has become a problem. It is important to develop alternative energy sources and hydrogen is attracting attention.

The hydrogen can be made from methane by a method called methane reforming, and it is known that Ni/Al_2O_3 catalysts are used in this reaction. A problem with this catalyst is the formation of carbon nanotubes on the surface of the reaction due to the migration of Ni particles during the reaction, which greatly reduces the efficiency of the reaction[1]. Various methods have been taken to solve this problem, but it can be solved by suppressing the migration of Ni by devising a surface structure.

We believe that the He induced nanostructures, in which fibrous nanostructures are formed on metal surfaces by He plasma, can be applied. These nanostructures are characterized by high-density nanostructures and have the advantage of large surface area.

In this study, we used He induced nanostructures on a Ni substrate to create an intertwined structure with Al_2O_3 film on the Ni surface in order to suppress the migration of Ni itself and improve its catalytic efficiency.

2、Experiment

Firstly, the Ni substrate was irradiated with He plasma at 480 °C for 2 hours using the ECR plasma irradiation system to form nanostructures on the surface. Al_2O_3 was deposited on the surface of the nanostructured sample by reactive magnetron sputtering. The films were evaluated by XPS, SEM and EDS.

The hydrogen activity of the Ni nanostructures was investigated by measuring the Mass3 spectra of the nanostructured and untreated samples exposed to hydrogen and deuterium, respectively, using the temperature-programmed desorption spectroscopy (TDS), in which the active hydrogen on the metal surface appears as H-D.

3、Result

The prepared sample showed a uniform deposition of alumina on Ni nanostructures (Fig. 1a). The XPS spectrum of 74.3 eV confirms that alumina was deposited on the Ni nanostructure.

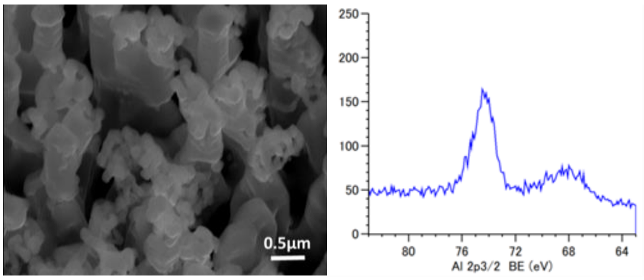

Fig1 (a)SEM picture (b)XPS spectrum

The hydrogen activity of the Ni nanostructures was investigated by adsorbing H and D on the surface and examining the temperature-programmed desorption spectra, as shown in Figure 2. The remarkable improvement in hydrogen storage properties was confirmed by the nanostructures, suggesting that the nanostructures have improved performance as a catalyst.

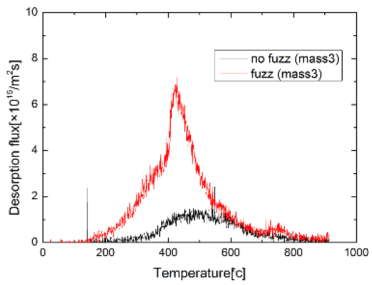

Fig2 TDS spectrum of Ni(Mass3)

[Reference]

[1]Shusaku Shoji *et al.*, Chem. Sci., 2019, 10, 3701-3705