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EXAFS characterization of In /SiO_2 as methane activation catalyst

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In /SiO_2 is methane selective activation catalyst. We carried out temperature-dependent EXAFS measurements on In /SiO_2 in order to reveal the disorder in the In particles.

1 Introduction

In showed highly selective conversion of CH_4 to C_2 compounds [1]. The reaction temperature was very high at 1100 K. The structure might be disordered after the reaction. We carried out temperature dependent EXAFS in order to see the static and thermal disorder of the In particles.

2 Experiment

EXAFS experiments were carried out in NW10A of Photon Factory Advanced Ring (PF-AR) using Si (311). The sample was pressed into the disk and then was loaded on the cryostat. We measured In K-edge XAFS spectra of three samples(before reaction, 3 hours and 12 hours after the reaction) at several temperatures..

3. Results

Figure 1 shows the Fourier transforms of In samples measured at 30 K. The Fourier transform clearly demonstrated that the In /SiO_2 had metallic In structure. In metal was square body-centred-cubic structure(I4/mmm, a=b=0.3244 nm and c=0.4938 nm.) Thus the two In-In distances were present in the first nearest neighbour as 0.324 and 0.337 nm with the coordination numbers of 4 and 8, respectively.

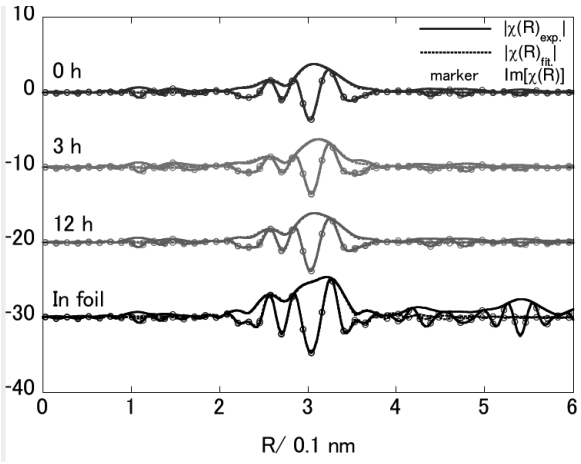

Figure 1 Fourier transform of In K-edge EXAFS measure at 30 K

We analysed the temperature dependence DW factors as shown in Figure 2. The DW factors of the In / SiO_2 were larger than that of In foil and they did not change so much with the reaction times. The origin of the large DW factors in In/SiO_2 was due to the static disorder.

4. Conclusions

The EXAFS analysis revealed that the metallic In particle was formed on the SiO_2 with large static disorder. Further in situ experiments were required to obtain the origin of the high performance of In catalysts.

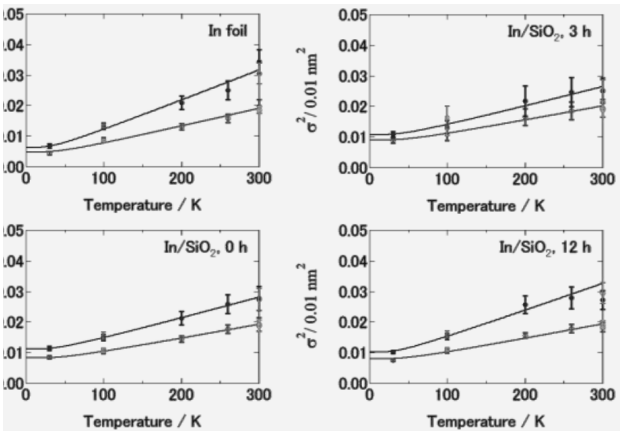

Figure 2 Temperature dependence of DW factor

Reference

[1] Nishikawa, Y.; Ogihara, H.; Yamanaka, I., Liquid‐Metal Indium Catalysis for Direct Dehydrogenative Conversion of Methane to Higher Hydrocarbons. *ChemistrySelect* **2017**, *2*, 4572-4576.

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