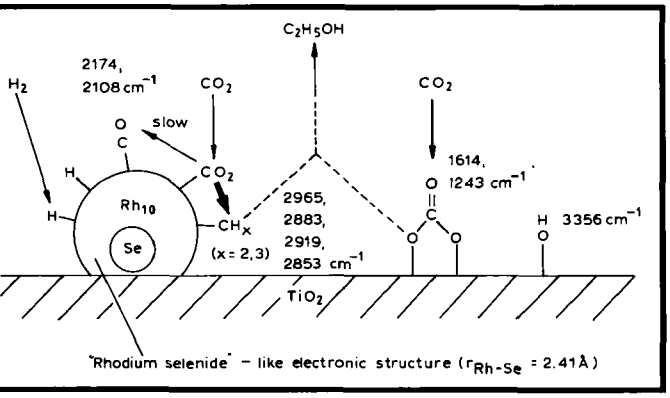

Fig. 1 The proposed reaction mechanism of ethanol synthesis from $CO_2 + H_2$ on $[Rh_{10}Se]/TiO_2$ catalyst. The reaction between CO(ads) and CH_x(ads) to form ethanol is also possible

shown in Figure 1. The stability of the CH_x(ads) on rhodium should be a key point, the rhodium site being affected by the interior negatively charged selenium (–1 ~ –2 by XPS) (12). The "rhodium selenide"-like electronic state inhibited methane formation, but tuned the reaction path to ethanol by promoting the C-C bond formation of CH_x with the carbonyl derivative.

Summary

Controlling the reaction path of $CO_2 + H_2$ to give ethanol was found to be possible due to the presence of carbon, oxygen, selenium, lithium and iron around rhodium sites. Electronic control by selenium for ethanol formation was investigated by several techniques, and electronic modification of the platinum metal cluster from within should be applicable to other systems.

References

1 E. L. Muetterties and M. J. Krause, *Angew. Chem., Int. Ed. Engl.*, 1983, **22**, 135

2 E. L. Muetterties and J. Stein, *Chem. Rev.*, 1979, **79**, 479

3 K. Klier, *Adv. Catal.*, 1982, **31**, 243

4 M. Bowker, *Catal. Today*, 1992, **15**, 77

5 Y. Izumi, K. Asakura and Y. Iwasawa, *J. Catal.*, 1991, **127**, 631

6 Y. Izumi, K. Asakura and Y. Iwasawa, *J. Catal.*, 1991, **132**, 566

7 H. Kusama, K. Sakama, K. Okabe and H. Arakawa, *Nippon Kagaku Kaishi*, 1995, 875

8 H. Kusama, K. Okabe, K. Sakama and H. Arakawa, *Energy*, 1997, **22**, 343

9 H. Kurakata, Y. Izumi and K. Aika, *Chem. Commun.*, 1996, 389

10 Y. Izumi and Y. Iwasawa, *J. Phys. Chem.*, 1992, **96**, 10942

11 Y. Izumi, H. Kurakata and K. Aika, *Hyomen-Kagaku (Surface Science)*, 1996, **17**, 242

12 Y. Izumi, H. Kurakata and K. Aika, submitted to *J. Catal.*

13 K. Nakamoto, "Infrared and Raman Spectra of Inorganic and Coordination Compounds", Third Ed., John Wiley & Sons, New York, 1970

14 For example, (a) J. S. Lee, K. H. Lee, S. Y. Lee and Y. G. Kim, *J. Catal.*, 1993, **144**, 414; (b) R. A. Koeppel, A. Baiker and A. Wokaum, *Appl. Catal. A*, 1992, **84**, 77

Hexagonal Nanostructured Platinum

Platinum particles can be prepared as nanostructures or monolayers, in polymers and in templates of ceramic materials by the reduction of platinum acids or salts. Researchers from the U.K. and Germany now report the use of a liquid-crystalline phase template to form nanostructured platinum (G. S Attard, C. G. Göltner, J. M. Corker, S. Henke and R. H. Templer, *Angew. Chem. Int. Ed. Engl.*, 1997, **36**, (12), 1315–1317).

Hexachloroplatinic acid and ammonium tetrachloroplatinate were added to the surfactant, octaethyleneglycol monohexadecyl ether, which was used to prepare the lyotropic liquid-crystalline phases because it forms a wide hexagonal mesophase. The platinum salts were reduced, forming platinum powder of particle size 90 to 500 nm of hexagonal nanostructure with cylindrical pores 30 Å in diameter, separated by 30 Å thick platinum walls. The lyotropic phase may act as a structure-directing medium. Platinum is stabilised at the hydrophobic/hydrophilic interface as small colloidal particles which agglomerate and coalesce to a stable wall thickness. Only fast reductions allow this structure to form before the liquid-crystal phase rearranges.

This nanostructured platinum is mesoporous and of large surface area – features useful for catalytic, fuel cell and sensor applications.