680th ASRC Seminar

Date：13:30 - 15:00 Tuesday, July 11

Location： 103 Meeting Room, ASRC Bldg.

Speaker：Prof. Jun Yoshinobu
(The University of Tokyo)

Title: The adsorption and activation of CO_2 and formic acid on Cu model catalysts

Abstract: Activation of CO_2 is an important topic in the efficient use of CO_2 as a chemical feedstock [1]. We investigated the adsorption and reaction of CO_2 and formic acid on Cu model catalysts using infrared reflection absorption spectroscopy (IRAS), X-ray photoelectron spectroscopy (XPS), temperature programed desorption (TPD), scanning tunneling microscopy (STM) etc. At low temperature below 70K, CO_2 is physisorbed on both Cu(111) and Cu(997) surfaces [2]. However, CO_2 molecules are dissociated to form chemisorbed CO above 80 K on Cu(997), but not on Cu(111). At 340 K on Cu(997) under CO_2 gas pressure of 0.8 mbar, a main reaction product on the surface was identified as carbonate (CO_3) [3].

The desorption and dissociation kinetics of formic acid (HCOOH) on Cu(111) were studied [4] using IRAS and TPD. The activation energy for desorption is estimated to be 52.8-74.6 kJ/mol from TPD results. For the first layer HCOOH, α-polymeric HCOOH species are formed below ~150K. A part of HCOOH species are dissociated into monodentate formate species. The activation energy for dissociation into formate species is estimated to be 65.0 kJ/mol from TR-IRAS results. The hydrogen bonding between adsorbed species plays an important role in the stabilization of HCOOH and monodentate formate on Cu(111).

References

[1] M. Aresta “Carbon dioxide as chemical feedstock” (Wiley-VCH, Weinheim, 2010).

[2] T. Koitaya et al., J. Chem. Phys. 144 (2016) 054703.

[3] T. Koitaya et al., Topics in Catalysis 59 (2016) 526.

[4] Y. Shiozawa et al., J. Chem. Phys. 143 (2015) 234707.

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