FT-ICR reaction study of bimetallic clusters with alcohol and hydrocarbon

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The chemical reaction of bimetallic clusters of transition metals, Fe/Co and Co/Mo, which are used for catalysts of carbon nanotube growth, is studied by FT-ICR (Fourier Transform Ion Cyclotron Resonance) mass spectrometer with laser-vaporization supersonic-expansion cluster beam source [1]. In order to investigate the initial reaction of alcohol or hydrocarbon with a metal nano-particle, we have been studying the chemical reaction of levitating metal clusters. Our previous FT-ICR studies have compared the reactivity of Fe, Co, and Ni clusters with ethanol. The dehydrogenation process on Co clusters was studied in detail by using isotopically modified ethanol. The dehydrogenation reaction was observed only limited size range of Co clusters: Co_{12} ~ Co_{17}. On the other hand, all Ni clusters tested always showed immediate dehydrogenation reaction, and no such reaction was observed for Fe clusters.

Here, the bimetallic clusters are studied for better insights on the initial reaction of catalysts with carbon containing molecules, such as alcohol and hydrocarbon. Fig. 1 shows mass spectra of bimetallic clusters generated by the laser-vaporization of Fe/Co (atomic ratio is 0.513:0.487) and Co/Mo (atomic ratio is 0.5:0.5) used as catalysts of ACCVD method [2]. The size dependent reactivity of Fe/Co clusters with ethanol was observed.

Fig. 1. FT-ICR mass spectra of laser-vaporized clusters generated from (a) Fe/Co, (b) Co/Mo.

References
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