Gold catalysts exhibit high catalytic activity for low temperature CO oxidation [1]. It has been reported that active site is interface between Au and metal oxide supports [2]. Activation of oxygen at the interface seems to be important step for the CO oxidation reaction. While CO molecules are adsorbed on Au surface, the oxygen seems to be activated at the interface between Au and metal oxide support. Details of mechanism of whole reaction is not clarified yet. On the other hand, addition of Ag also improves the activity of Au catalysts [3,4]. It is significant to investigate the mechanism of improvement of the activity by adding Ag in order to study the general mechanism of oxygen activation for low temperature oxidation. In this study, Au-Ag bimetallic catalyst was prepared by simultaneous solid grinding method using Me₂Au(acac: acetylacetonate) and Ag(acac). Au and Ag precursor and supports was physically mixed for 20min in Ar atmosphere. Subsequently, the catalysts were calcined at 300°C for 4 hours in air. Catalytic activity was measured by using a fixed bed reactor and a standard gas containing 1 vol.% CO in air. The structure of Au-Ag bimetallic catalysts was observed by aberration corrected TEM/STEM (FEI Titan3 G2 60-300). EDS measurement was carried out by high sensitive EDS system, Super-X (Bruker) equipped with 4-silicon drift detectors (SDD).

Figure 1 indicates catalytic activity for CO oxidation of Au/SiO₂ and Au-Ag/SiO₂ catalysts. It is clearly confirmed that the catalytic activity of Au/SiO₂ is improved by addition of Ag. This effect is prominent for inert supports such as SiO₂ and Al₂O₃. Figure 2 shows ADF-STEM image of Au-Ag/SiO₂ catalyst. Nanoparticles with the diameter of 2-10 nm are well dispersed on the SiO₂ support by solid grinding method. Elemental maps by EDS were carried out and both Au and Ag signal was detected from most nanoparticles. This is indicating that the Au-Ag bimetallic nanoparticles are formed by simple mixing of individual organic complexes of Au and Ag by solid grinding method.

References

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Fig. 1: Catalytic activity for CO oxidation of Au/SiO₂ and Au-Ag/SiO₂ catalysts. SV: 20000mLh⁻¹g-cat⁻¹

Fig. 2: ADF-STEM image of Au-Ag/SiO₂ catalyst.