Nanostructured Palladium Incorporated in MCM-41 Materials

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Highly dispersed palladium nanoparticles containing mesoporous silicas MCM-41 and MCM-48 were prepared by one-pot synthesis. The complex-surfactant aggregates $[CTA]_2[PdBr_4]$ were considered to be generated in the presence of a large amount of CTAB. The synthesis of MCM-41 mesophase templated by CTA^+ surfactant and the generation of PdO species through the reaction between $[PdBr_4]^{2-}$ and hydroxide anion may occur simultaneously. Those PdO nanoparticles were reduced to Pd metal by hydrogen treatment and found to stay inside the mesochannels of MCM-41 as detected by TEM, XAS, and PXRD. In hydrothermal synthesis of Pd/MCM-48, Pd nanoparticles of average size ≈7 nm were found to be deposited on the MCM-48, probably derived from ethanol reduction of Pd (II) complex. Moreover, the template removal from MCM-41 was observed to be catalyzed by Pd(0) nanoparticles.

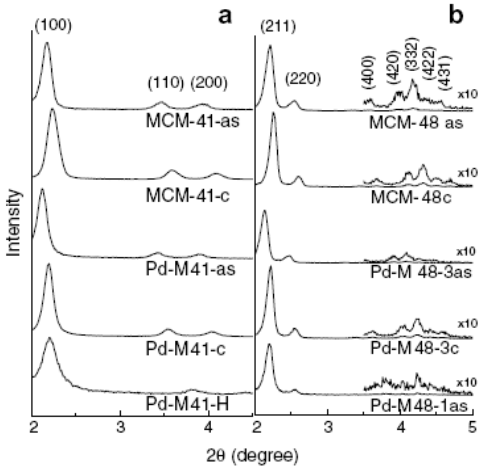

Figure 1. Low-angle PXRD patterns of mesostructured: (a) MCM-41-s (b)and MCM-48-s.

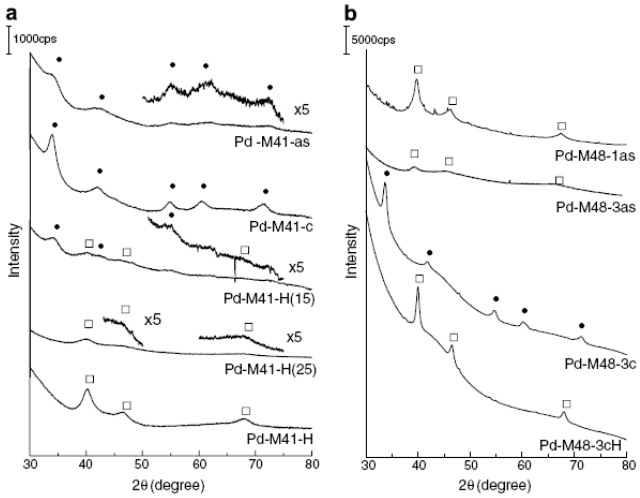

Figure 2. High-angle PXRD patterns of Pd incorporated in (a) MCM-41-s and (b) MCM-48-s. Open squares (□) and filled circles (●) represent the diffraction patterns of Pd and PdO, respectively. (Pd-M41-H(15) was measured with k = 1.3344Å and, others were measured with k = 0.7749Å ; all patterns are converted to k = 1.5418Å).