Photo-induced Surface Property on Transparent Me(=Ti,Cr)-containing Mesoporous Silica Thin Films

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Ti-containing mesoporous silica (TMS) has attracted a wide range of scientific and practical interests [1,2]. Although the super-hydrophilicity of TiO_2 thin film has already been observed under UV-irradiation, the photo-induced surface properties of TMS thin films are of special interest. In this study, Me(=Ti,Cr)-containing mesoporous silica thin films have been prepared on quartz plate by the spin-coating sol-gel method and investigated on the surface hydrophilic property.

The Me(=Ti,Cr)-containing mesoporous silica thin films were prepared using TEOS, tetraethyl orthotitanate (TEOT) or chromium nitrate 9-hydrate, Brij30, hydrochloric acid and ethanol. The mixture was stirred, dripped onto a quartz substrate, spun coated and calcined at 525 K.

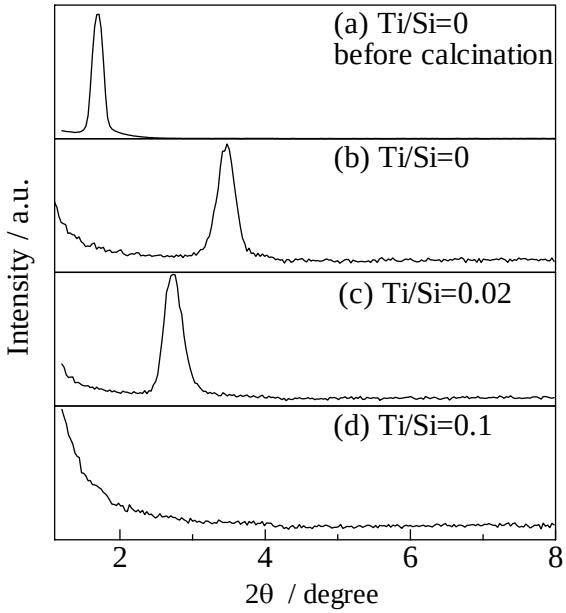

Figure 1: XRD patterns of (a), (b) MS and (c), (d) TMS thin films.

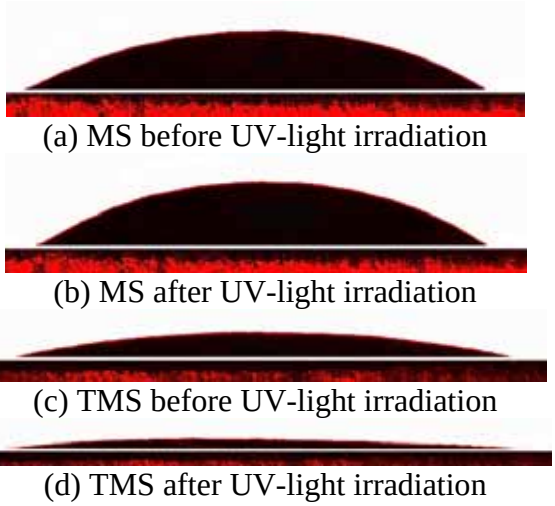

Figure 2: The images of water droplets observed before and after UV-light irradiation on the MS and TMS (Ti/Si=0.01).

Me(=Ti,Cr)-containing mesoporous silica thin films were synthesized to be transparent and well-fixed on the substrate of quartz plate. Figure 1 shows XRD patterns of Ti-containing mesoporous silica (TMS) thin films. The TMS thin films, exhibit a diffraction peak at around 2-3 degree indicating the presence of mesoporous structure. Both TMS and CMS thin films exhibited an intense single preedge peak in the XAFS spectra indicating that the titanium oxide or chromium oxide moieties in TMS or CMS thin films have a tetrahedral coordination. Figure 2 shows the images of water droplets on the MS and TMS thin films deposited on quartz plate. The water contact angles on TMS thin films were much smaller than on MS thin films even before UV-light irradiation. After UV-light irradiation, the water contact angle on TMS thin films become very small, while the water contact angle on MS thin films do not make any changes. These results indicate that TMS thin films can exhibit the photo-induced super-hydrophilic property. Furthormore, On CMS thin films, the surface hydrophilic-hydrophobic properties can be controlled by the photocatalytic reaction for ethylene polymerization.

[1] S. Nishio, N. Nishiyama, H. Yamashita, Stud. Surf. Sci. Catal., 158 (2005) 1605.

[2] H. Yamashita, S. Nishio, N. Nishiyama, T. Omichi, I, Katayama, Catal Today,111 (2006) 254.