

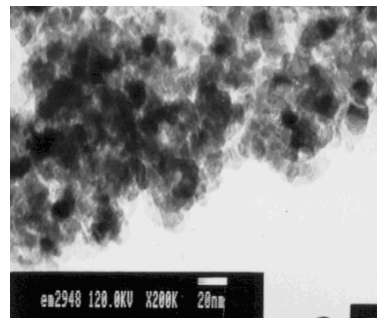
# XAS Study on the Cu and Cr Electronic States and Molecular Environments of Red-Shift Metal Compound-Doped TiO<sub>2</sub> Nanoparticles

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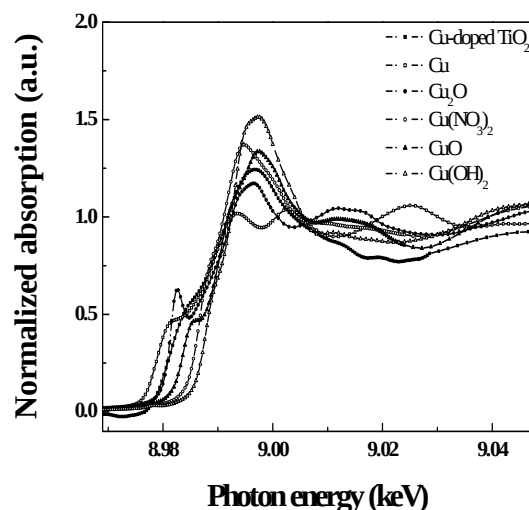
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Titanium oxide can decompose many organic and inorganic pollutants by irradiation under UV light; however UV light only represents approximately 5% of total sun irradiation, and there have been extensive studies in visible light active photocatalysts effected by doping metal compound into titanium oxide. In this study, visible light active photocatalysts have been successfully prepared by incorporating Cu into TiO<sub>2</sub> by the use of modified sol-gel processes.

The TEM micrographs (Figure 1) showed that the sizes of our metal compound-doped TiO<sub>2</sub> particles were approximately 15 nm. XRD patterns only demonstrate the existence of anatase TiO<sub>2</sub> phase; crystalline phase associated with Cu was not found, probably due to the fact that Cu content was low. SEM/EDS results also only show the presence of Ti and oxygen. The results from UV-Vis absorption spectra indicate that greater amount of Cu doping tends to result in greater absorption in both UV and visible light. The Cu k-edge XANES results (Figure 2) indicate that the average oxidation state of Cu decreases as the amount of Cu dopant decreases. The white band became greater with the increase of copper dopant. It is thus proposed that the reduction in Cu oxidation state may result in formation of Cu element that acts as an electron acceptor to delay the recombination of electron hole pair. Photo-degradation of methylene blue catalyzed by Cu-doped TiO<sub>2</sub> under irradiation of visible light (460 nm) was studied. We found that Cu-doped TiO<sub>2</sub> showed much better catalytic ability in oxidizing methylene blue under visible light irradiation than TiO<sub>2</sub> did. Note that methylene blue has frequently been employed in the studies of photocatalytic activity, as extensively reported in literature. Similar photocatalytic results under visible light irradiation have been quite rarely reported in literature although red-shift phenomenon has been often observed in some cases of metal-doped TiO<sub>2</sub> (1-5). Liu et al examined the mechanism for enhanced photocatalytic activity of Ag-loaded TiO<sub>2</sub>; phenol oxidation by Cr(VI) under UV light by the use of Ag/TiO<sub>2</sub> was used as the studied case. Red-shift phenomenon was found but no photocatalytic oxidation result under visible light was reported (4). Although Chiang et al showed that red-shift phenomenon was achieved by loading CuO on Dagussa P25 TiO<sub>2</sub> through photodeposition, yet no photocatalytic degradation of pollutant in visible light region was observed (5). They only reported the photocatalytic degradation of CN<sup>-</sup> under UV irradiation (5).



**Figure 1.** Typical TEM morphology from Cu-dope TiO<sub>2</sub> catalyst.



**Figure 2.** Cu K-edge spectra from Cu-doped TiO<sub>2</sub> and five copper references.

## Reference

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