

Role of TiO₂ in Enhancing Sulfur Resistance of Supported Metal Catalysts (I): Structure of TiO₂ on Zeolite

Jyh-Fu Lee (李志甫)¹, Hwo-Shuenn Sheu (許火順)¹,
Wen-Chi Lin (林雯琦)², and Jen-Ray Chang (張仁瑞)²

¹Department of Chemical Engineering, National Chung Cheng University, Chiayi, Taiwan

²National Synchrotron Radiation Research Center, Hsinchu, Taiwan

Strong TiO₂-metal interaction has been attracting a great attention in the last two decades due to its enhancement of the catalytic properties of the metal on TiO₂. Catalytic performance results have also indicated that TiO₂ grafted supported Pt, Pd catalysts present much higher sulfur resistance than those without TiO₂. However, the sulfur resistance of the catalysts is greatly affected by the morphology of TiO₂. To facilitate the fundamental understanding the chemistry of the effects, the material system is carefully designed. Zeolite were chosen as the support, because zeolite, which have high surface area, higher thermal stability than TiO₂ towards sintering at high temperature, allows the TiO₂ grafted zeolite having high TiO₂ coverage. To demonstrate how zeolite properties influence the morphology of TiO₂, Y zeolite of different Si to Al ratio, namely, CBV 760 (Si/Al=60) and CBV 600 (Si/Al=5) were chosen. After grafting Ti(OCH(CH₃)₂)₄ on zeolite followed with the calcination in air at 450 °C, the materials were characterized by XANES (Figure 1) and EXAFS (Figure 2) and the results indicated that the structure of TiO₂ resembling monolayer and multilayer were presented for CBV 760 and CBV600, respectively. The results suggest that the surface properties of zeolite, specifically, the water containing influences the morphology of TiO₂. CBV 760 is more hydrophobic than do CBV 600, thus, less polymerization of TiO₂ precursor occurs during the grafting process, leading to a monolayer of TiO₂.

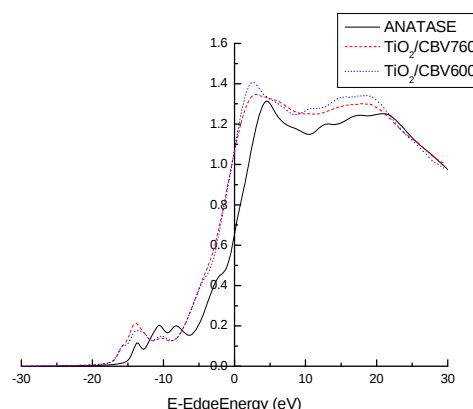


Figure 1. Normalized Ti K absorption data for anatase, TiO₂ grafted on high Si/Al zeolite (TiO₂/CBV760), and TiO₂ grafted on high Si/Al zeolite (TiO₂/CBV600).

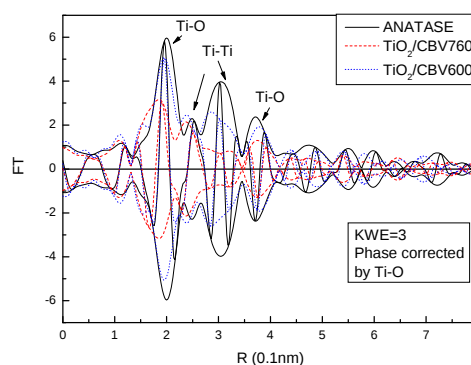


Figure 2. Comparison of the magnitude of Fourier transforms (k^3 -weighted, Ti-O phase corrected, $k = 3.5.0-10.0 \text{ \AA}^{-1}$) of EXAFS characterizing anatase, TiO₂ grafted on high Si/Al zeolite (TiO₂/CBV760), and TiO₂ grafted on high Si/Al zeolite (TiO₂/CBV600).