Nanoparticle Decoration of Carbon Nanotubes by X-ray Irradiation

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A new technology to modify Multi-Wall carbon nanotubes (MWNTs), TiO_2 nanoparticles were attached to the nanotube and locations of functional groups were further confirmed. Using synchrotron radiation source develops of sol-gel solutions for the formation of TiO_2/MWNTs hybrid material. The surface properties of MWNTs could be change by intensity or exposure time of X-ray. By X-ray interaction, the MWNTs could be successfully coated with about 15nm TiO_2 nanoparticles. Thus while this approach is envisaged to be quite challenging, its success will provide new fundamental knowledge and tremendous opportunities for the synthesis of hybrid material. The X-ray absorbation data were collected using synchrotron radiations at 20A1 BM – (H-SGM) beam lines. Material synthesized to achieve in the 01A1 SWLS. The X-ray irradiation step as shown in Figure 1.

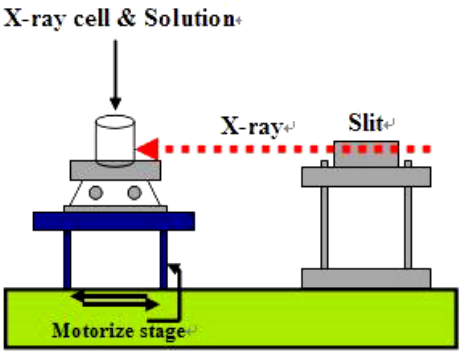

Figure 1. The schematic diagram of the synchrotron X-ray irradiation setup.

Figure 2 (a) and (b) summarizes the O K-edge and Ti L-edge features of TiO_2 at differences X-ray exposure times. The NEXAFS spectra were recorded using the fluorescence-yield (or sample current) method to assure the measurements of nanoparticles stoichiometries of the titanium oxides. Figure 4 clearly indicates that both the O K-edge and Ti L-edge features are very sensitive to the oxidation states of titanium. The local coordination of oxygen in TiO_2 is octahedral for these oxides. As the oxidation state of Ti changes, the energy difference of $\Delta E(e_g - t_{2g})$ in the O K-edge decreases about 2.7 eV for TiO_2. In the Ti L-edge, the four separate L_3-t_{2g}, clearly indicated by the following spectral in the O K-edge features: (1) the $\Delta E(e_g - t_{2g})$ in the O K-edge have 2.7eV for stoichiometric TiO_2 at different X-ray exposure times. (2) The O K-edge features at 531.3, 534.0, 539.3 and 544.8eV were observed at different X-ray exposure times. Furthermore, the X-ray induced reaction method is also supported by the following spectral in the Ti L-edge features: (1) the conversion of the four well separated L_3-t_{2g}, L_3-e_g, L_2-t_{2g} and L_2-e_g features of TiO_2 to four broad peaks and (2) the subsequent gradual intensity of the peak is increase as the X-ray exposure time increases. The characteristic changes in the O K-edge and Ti L-edge regions clearly indicated a conversion of TiO_2 to oxides with lower oxidation states as result of X-ray exposure method. In the XAS results, it is clearly that TiO_2 can attach to MWNTS successful by X-ray exposure method.

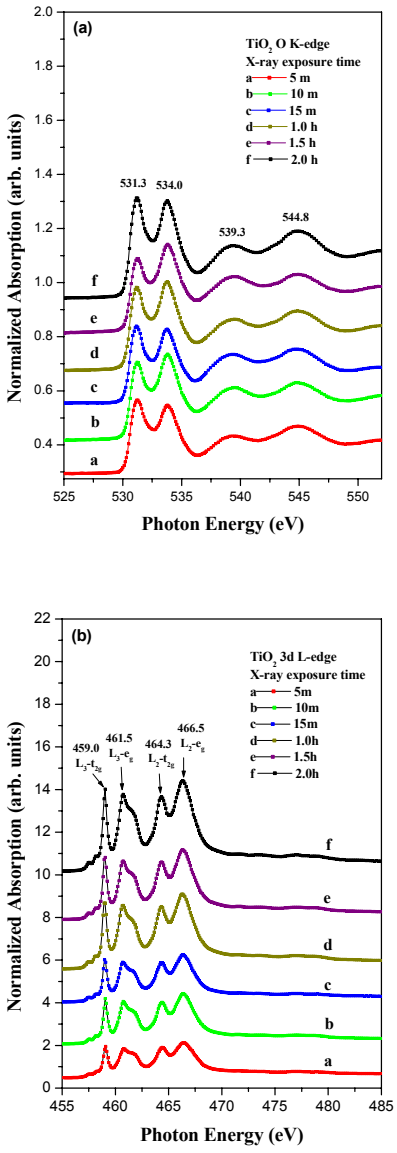

Figure 2. Comparison of O K-edge (a) and Ti L-edge (b) features for TiO_2. NEXAFS measurements were carried out by measuring the fluorescence yield to assure nanoparticle for TiO_2.