

Speciation of Zinc in Nano Phosphor Particulars Abstracted in an Ionic Liquid

H. H. Hsu (徐煥炫) and H. P. Wang (王鴻博)

Department of Environmental Engineering, Cheng Kung University, Tainan, Taiwan

Phosphor particulates escaped from filtration systems of the TV, monitor or FEDs disassembling processes are frequently found in nano or submicron sizes. Nano size (<100 nm) pollutants have been controlled negligibly in the conventional air pollution control devices. The hidden dangers of nano-pollutants from many sources such as particulate matters from coal-fired power plants, and waste incinerators may exacerbate the environment and human health on a daily basis.

Room temperature ionic liquids (RTILs) have raised increasing interests in applications of synthesis, separation, and electrochemistry. In the separated experiments we found that nano copper species in the CMP waste water can be effectively extracted by RTILs. However, chemical structures of nano particulates abstracted in RTIL have not been well studied. Molecular structure and composition of select elements can be revealed by X-ray absorption near edge structural (XANES) spectroscopy. Thus, the main objective of this work was to study speciation of zinc in nano pollutants such as phosphor fly ashes abstracted in the RTIL - [C4min][PF6] by in situ XANES.

XANES To understand chemical structure of zinc species in the phosphor particulates, XANES spectra of zinc were determined. The least-square fitted XANES spectrum of the phosphor is shown in Fig. 1. The main zinc species in phosphor were ZnS (88%) and ZnO (12%). The nano phosphor particulates (<200 nm) was abstracted in the RTIL ([C4min][PF6]). The SEM topology of the phosphor particulates suspended in the RTIL are mainly in the nano sizes (<100 nm) (Fig. 2). It seems that the nano species was not involved in aggregation in the RTIL. ¹H-NMR spectra (in Fig. 3) show the protons of the RTIL was highly perturbed during abstraction of nano phosphor particulates. A small amount of 1-methylimidazole at 2.30, 4.69, 4.88 and 5.07 ppm was observed in the RTIL solvent. 1-methylimidazole in the RTIL was found in down field shifts in Fig. 3(b) during abstraction of nano ZnS or ZnO in the phosphor particulates. Fig. 3(b) also showed the ¹H-NMR spectra of Zn²⁺ abstracted in 1-methylimidazole. It was clear that protons in the imidazole (see chemical structure of 1-methylimidazole in Fig. 3(b)) were highly perturbed because of the chelation of N of the imidazole with Zn²⁺.

The component fitted XANES spectra of the phosphor particulates show that the main zinc species in phosphor are ZnS (88%) and ZnO (12%). ¹H-NMR spectra showed the Zn²⁺ was abstracted in 1-methylimidazole that can be abstracted into the RTIL. Nano ZnS and ZnO could be suspended in the RTIL for at least 10 days.

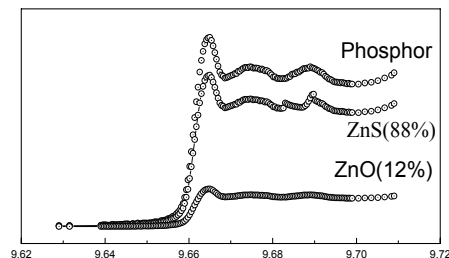


Figure 1. Component fitted XANES spectra of zinc species in the phosphor particulates.

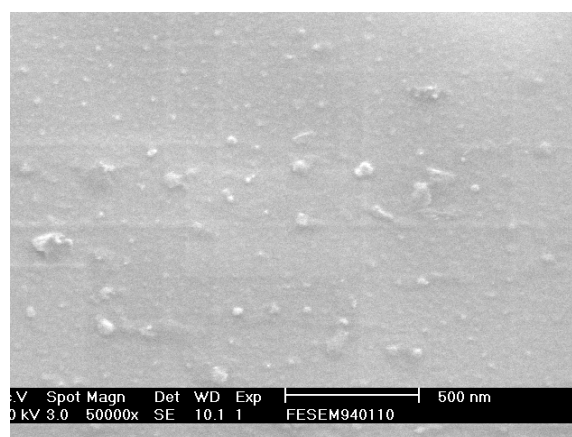


Figure 2. Nano particles abstracted in the RTILs observed by SEM.

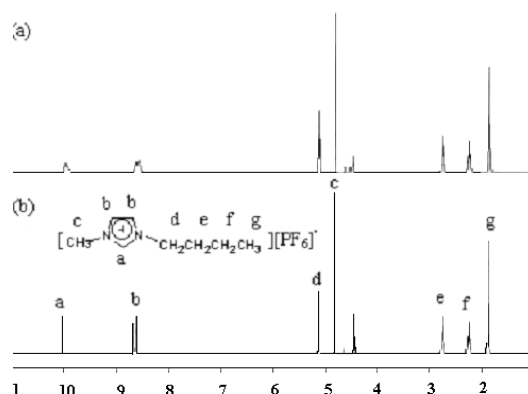


Figure 3. ¹H-NMR spectra of (a) RTIL and (b) nano phosphor particulates abstracted in 1-methylimidazole.

Submitted in Radiation Physics and chemistry