Preparation of Styrene-Ethyl acylate Core-shell Structured Detection Materials for a Measurement of the Wall Contamination by Emulsion Polymerization

Ho-Sang Hwang, Bum-Kyoung Seo, Dong-Gyu Lee, Kune-Woo Lee
Korea Atomic Energy Research Institute 1045 Daedeok-daero, Yuseong-gu, Daejeon 305-353, Korea
hshwang@kaeri.re.kr

New approaches for detecting, preventing and remedying environmental damage are important for protection of the environment. Procedures must be developed and implemented to reduce the amount of waste produced in chemical processes, to detect the presence and/or concentration of contaminants and decontaminate fouled environments. Contamination can be classified into three general types: airborne, surface and structural. The most dangerous type is airborne contamination, because of the opportunity for inhalation and ingestion. The second most dangerous type is surface contamination. Surface contamination can be transferred to workers by casual contact and if disturbed can easily be made airborne.

The decontamination of the surface in the nuclear facilities has been widely studied with particular emphasis on small and large surfaces. The amount of wastes being produced during decommissioning of nuclear facilities is much higher than the total wastes cumulated during operation. And, the process of decommissioning has a strong possibility of personal's exposure and emission to environment of the radioactive contaminants, requiring through monitoring and estimation of radiation and radioactivity. So, it is important to monitor the radioactive contamination level of the nuclear facilities for the determination of the decontamination method, the establishment of the decommissioning planning, and the worker's safety. But it is very difficult to measure the surface contamination of the floor and wall in the highly contaminated facilities.

In this study, the poly(styrene-ethyl acrylate) [poly(St-EA)] core-shell composite polymer for measurement of the radioactive contamination was synthesized by the method of emulsion polymerization. The morphology of the poly(St-EA) composite emulsion particle was core-shell structure, with polystyrene (PS)as the core and poly(ethyl acrylate) (PEA) as the shell. Core-shell polymers of styrene (St)/ethyl acrylate (EA) pair were prepared by sequential emulsion polymerization in the presence of sodium dodecyl sulfate (SDS) as an emulsifier using ammonium persulfate (APS) as an initiator. The polymer was made by impregnating organic scintillators, 2,5-diphenyloxazole (PPO) and 1,4-bis[5-phenyl-2-oxazol]benzene (POPOP). Related tests and analysis confirmed the success in synthesis of composite polymer. The products are characterized by FT-IR spectroscopy, TGA that were used, respectively, to show the structure, the thermal stability of the prepared polymer. Two-phase particles with a core-shell structure were obtained in experiments where the estimated glass transition temperature and the morphologies of emulsion particles. Radiation pollution level the detection about under using examined the beta rays.

The morphology of the poly(St-EA) composite polymer synthesized by the method of emulsion polymerization was a core-shell structure, as shown in Fig. 1. Core-shell materials consist of a core structural domain covered by a shell domain. Clearly, the entire surface of PS core was covered by PEA. The inner region was a PS core and the outer region was a PEA shell. The particle size distribution showed similar in the range 350-360 nm.

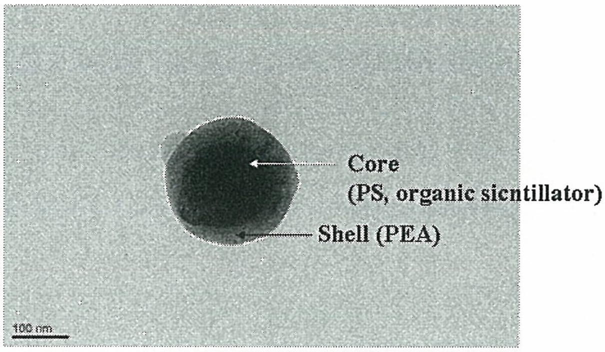

Fig. 1 TEM image of poly(St-EA) composite polymer particle

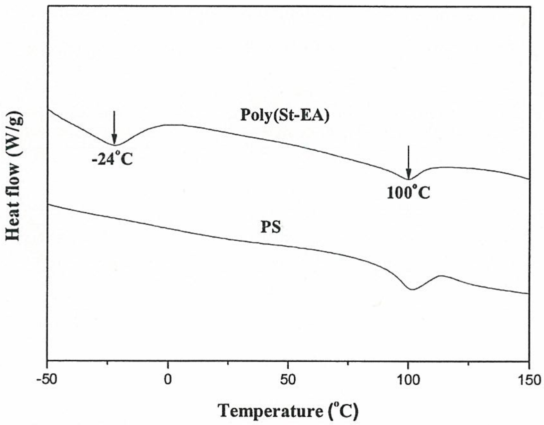

Fig. 2 DSC curves of PS and poly(St-EA) polymer