A Study of Indium Extraction with Carboxylic Acids with the Aim to Produce Scintillators for Solar Neutrino Detection by LENS Spectroscopy of Low-Energy Neutrino

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Abstract—The physicochemical properties of C_4–C_8 carboxylic acids (mutual solubility of carboxylic acids and water, ionization constants in water, distribution between water and 1,2,4-trimethylbenzene, dimerization constants in 1,2,4-trimethylbenzene) were studied. Since indium carboxylates are sparingly soluble in 1,2,4-trimethylbenzene and the second organic phase is formed in the system, In-containing scintillators can be prepared from C_4–C_5 acids only in the presence of neutral organophosphorus compounds. The best results were obtained with an extracting agent containing isovaleric acid (C_5) and 0.25 M triisoamylphosphine oxide. The scintillator prepared in this system contained 80 g l^{-1} In and had a transparency of up to 2 m and a 40% light output. These parameters did not change when the sample was stored in tightly sealed dark glass vessels for 2 years at 12–34°C in an argon atmosphere. Acids C_6–C_8 can be used for In extraction without organophosphorus additives. The best results were obtained with methylvaleric acid (H_2MVA, C_6). The correlation between the transparency and light output of the scintillators, on the one hand, and the preparation conditions, on the other hand, was studied. The properties of scintillators prepared from solutions of polymeric indium hydroxy-2-methylvalerates in 1,2,4-trimethylbenzene $\{[In(2MVA)_{0.8}(OH)_{2.2}]_n$ (n = 9–115)$\}$ were the best. A procedure for extracting indium hydroxycarboxylates and preparing scintillators suitable for LENS experiment was developed. Scintillators with a volume of 4 l, an In concentration of 50 g l^{-1}, a light output more than 65%, and a 3-m transparency were prepared.