Abstract

Use of ion selective electrodes can cater an important role in the chemical characterization of the nuclear fuel materials. The indigenously developed coated ion selective electrodes can be employed for the quantitative determination of various elements viz. (i) lithium by either by titrimetry or coated Li-ISE for ITER process, (ii) uranium in sintered UO\textsubscript{2} and (U,Th)O\textsubscript{2} with respect to third generation of nuclear fuel viz. AHWR using U-ISE, (iii) gallium in pure metal samples or alloy such as Pu-Ga samples.

A titrimetry method has been developed for the determination of lithium in wash solution resulting during the preparation of lithium meta titanate (Li\textsubscript{2}TiO\textsubscript{3}) microspheres using fluoride ion selective electrode with potentiometric end point detection for the first time. These studies would be highly useful in the optimization of the washing parameters in sol-gel process for obtaining phase pure lithium titanate pebbles. In addition to maintaining the stoichiometry, the investigations would also be helpful to reduce the loss of enriched Li\textsuperscript{6}. Another method was developed using coated wire Lithium ion selective electrode for the purpose of determining lithium in the organic matrix after suitable treatment of the sample during the preparation of lithium meta titanate (Li\textsubscript{2}TiO\textsubscript{3}) microspheres.

A method was developed for the determination of uranium in sintered UO\textsubscript{2} pellets and in the synthetic mixture containing uranium and thorium (AHWR type fuel) using coated graphite uranium ion selective electrode. This coated graphite uranium ion selective electrode exhibits linear Nernstian response over uranyl concentration range of 1x10\textsuperscript{-4}M - 1x10\textsuperscript{-1}M in constant chloride concentration of 6M with a slope of -29.2±1.0 mV/concentration decade and a detection limit of 5 x 10\textsuperscript{-5}M for the Aliquat 336 loaded UO\textsubscript{2}Cl\textsubscript{4}\textsuperscript{2-} and PVC composition in the ratio of 70:30. The life time of the electrode was found to be four months with consistent use. This coated graphite uranyl ion selective electrode was successfully employed for the online determination of uranium in sintered UO\textsubscript{2} samples as well as synthetic (U,Th)O\textsubscript{2} samples.

Coated graphite gallium ion selective electrode was developed for the determination of gallium and the performance of the electrode was checked. This indigenously developed coated graphite Ga-ISE exhibits linear Nernstian response over gallium concentration range of 1 x 10\textsuperscript{-1} M - 1 x 10\textsuperscript{-4} M of Ga(III) ions in constant chloride concentration of 6M with a calibration
slope of -58.2mV ± 1.0 mY/decade change in concentration of Ga.

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