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Comparative Study of LaBr₃(Ce) and CZT Array on Determination of Uranium Enrichment for Nuclear Safeguards Application

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Uranium enrichment is one of the most important factors in nuclear material safeguards. The accuracy of the IAEA's verification methods is dependent upon the type for a radiation detector used during inspections. The IAEA's COMPUCEA (COMBined Procedure for Uranium Concentration and Enrichment Assay) employs the use of LaBr₃(Ce) to measure uranium enrichment at low-enriched uranium fuel fabrication plants. The most important feature of COMPUCEA is its use for on-site analytical measurement. To improve accuracy and convenience of COMPUCEA as an in-field measurement instrument, this paper will examine ways of replacing LaBr₃(Ce) with cadmium zinc telluride (CZT). Low detection efficiency of CZT (which is the major drawback in radiation measurement) can be addressed by adopting several-CZT arrays. The Monte Carlo simulation (MCNPX) shows that a dual crystal array of two 1.5 cm x 1.5 cm x 0.75 cm has similar detection efficiency to that of a 5.08 cm (Dia.) x 2.54 cm (Length) LaBr₃(Ce). Good energy resolution and the small size of the CZT would make it possible to develop more accurate and convenient COMPUCEA-like instrument. Adoption of an array-type CZT detector can also reduce power consumption. How to design an optimal CZT array, and to realize a CZT array-based uranium enrichment measurement system will be discussed in detail at the conference.

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