GENERAL APPROACH TO MATERIALS CLASSIFICATION USING NEUTRON ANALYSIS TECHNIQUES

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The 'neutron in, gamma out' method of elemental analysis has been known and used in many applications as an elemental analysis tool. This method is non-intrusive, non-destructive, fast and precise. This set of advantages makes neutron analysis attractive for even wider variety of uses beyond simple elemental analysis. The question that is addressed within this study is under what conditions neutron analysis can be used to differentiate materials of interest from a group or class of materials in the face of knowing that what is truly of interest is the molecular content of any sample under interrogation. Purpose of the study was to develop a neutron-based scanner for rapid differentiation of classes of materials sealed in small bottles. Developed scanner employs D-T neutron generator as a neutron source and HPGe gamma detectors.

Materials can be placed into classes by many different properties. However, neutron analysis method can be used only few of them, such as elemental content, stoichiometric ratios and density of the scanned material. Set of parameters obtainable through neutron analysis serves as a basis for a hyperspace, where each point corresponds to a certain scanned material. Sub-volumes of the hyperspace correspond to different classes of materials.

One of the most important properties of the materials are stoichiometric ratios of the elements comprising the materials. Constructing an algorithm for converting the observed gamma ray counts into quantities of the elements in the scanned sample is a crucial part of the analysis. Gamma rays produced in both fast inelastic scatterings and neutron captures are considered. Presence of certain elements in materials, such as hydrogen and chlorine can significantly change neutron dynamics within the sample, and, in turn, characteristic gamma lines development. These effects have been studied and corresponding algorithms have been developed to account for them.

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