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Monte-Carlo gamma response simulation of fast/thermal neutron interactions with soil elements

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Soil elemental analysis using characteristic gamma rays induced by neutrons is an effective method of *in situ* soil content determination. The nuclei of soil elements irradiated by neutrons issue suitable for analysis characteristic gamma rays due to both inelastic neutron scattering (e.g., Si, C) and thermal neutron capture (e.g., N, Cl). To apply this method for quantitative analysis of soil elements, the effect of soil density, soil moisture, element distribution by depth, and other factors influencing the gamma response intensity should be determined. The Monte-Carlo (MC) simulation of gamma response spectra of modeled soil samples irradiated by neutrons is a very effective method for determining the above mentioned dependencies. A simulation model using the Geant4 toolkit was developed to define the effect of different soil parameters on the gamma response intensity. For instance, the direct proportional dependencies between the intensity of the 4.43 MeV gamma peak attributed to carbon nuclei and the average carbon weight percent in the upper 10 cm soil layer for any carbon depth profile was demonstrated. Both the MC simulation model and results of gamma response simulation from neutron irradiated soils with different characteristics (i.e., C content, density, moisture, different elemental depth profiles) will be presented and discussed. Findings from simulation results were used to conduct experimental soil elemental analysis using characteristic gamma rays induced by neutrons.

Biography

Aleksandr Kavetskiy has completed his PhD from Leningrad Institute of Technology (USSR). He has 30 years of experience in the field of Applied Nuclear Physics and Radiation Chemistry. He has published more than 30 papers in reputed journals. Now, he works on application of nuclear physics methods for soil elemental analysis in National Soil Dynamics Laboratory, ARS – USDA.

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