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Study of charged particle activation analysis evaluation of determination sensitivity for multi elemental samples by γ-ray simulation

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Charged particle activation analysis (CPAA) combined with a small accelerator is a versatile, non destructive, and high accuracy elemental analysis method. We have reported in the previous investigation that CPAA covers whole nuclear mass region including heavy elements, although CPAA has mainly applied for light elements so far. We have derived the determination sensitivity for single element samples by referring to nuclear database of Exfor and Nudat pepared by National Nuclear Data Center in Brookhaven National Laboratory. In the actual application for multi elemental samples we often need to know the determination sensitivity of individual element under the existence of matrix elements. While the sensitivity of an element of interest needs to be measured experimentally so far, the recent progress of radiation simulation code makes it possible to calculate it by computer simulation. For this purpose, we at first configure the geometry of the detector apparatus in Geant 4.10.2 code. Then we run the code by generating radiations from radioactive nuclides placed at the center. The energy deposit of the apparatus is recorded in event-by-event mode, producing the response of each detector material. From the event data reliable -ray spectra are derived. A database of -ray spectra for 197 radioactive nuclides with Z between 4(Be) and 92(Np) produced by CPAA has been prepared. From the database we can synthesize a realistic -ray spectrum for a multi elemental sample with any elemental configuration, in which the detection limit of each element is derived from the peak and continuum background counts. The present method has been tested for a standard rock sample of JB-1a and its effectiveness has been proved.

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