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Instrumental neutron activation analysis with anticoincidence counting significantly reduces interferences from 82Br and 122Sb to allow reliable measurements of nanogram levels of arsenic in biological materials via 76As

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Neutron activation analysis (NAA) can be conveniently used to measure microgram amounts of arsenic. However, in biological materials major elements such as bromine, chlorine, and sodium can produce high activities resulting in poorer detection limits for arsenic. The 559.1-keV photopeak of 76As (half-life = 25.9 h) is particularly interfered with by the 554.3-keV photopeak of 82Br (35.3 h) and 564.1-keV photopeak of 122Sb (65.3 h). The modern HPGe detectors have good enough resolution for separating these three peaks. However, when bromine content is high, the tailing of 554.3-keV photopeak can mask the 559.1-keV photopeak of 76As and can make the detection of the arsenic peak rather difficult, if not impossible. In practice instrumental NAA (INAA) methods can only be used to measure arsenic down to a few ppm levels in biological materials. The 76As nuclide decays by β-emission and two major gamma-rays, namely 559.1 and 657.0 keV, which are partially coincident. The peak efficiency reduction factors (PERF) of these peaks have been measured as 0.83 and 0.24, respectively. INAA in conjunction with anticoincidence counting technique can be beneficially used under such situations. The concentrations of arsenic in several reference materials were determined by irradiating them at a neutron flux of 5 × 1011 cm-2 s-1 for 7 h, followed by decay for about 50 h and counting for 8 h. The anticoincidence gamma-ray spectrometer used in this work consisted of a HPGe detector and a 10”x10” NaI(Tl) guard detector with a 3”x3” NaI(Tl) plug. The peak-to-Compton plateau ratio of this system is about 590:1. The application of anticoincidence spectrometry was found to reduce the 554.3 keV peak of 82Br, and to suppress the background under the 559.1 keV peak of 76As. The background activities in the anticoincidence spectra were reduced by factors of 4 to16 for the biological reference materials analyzed making the measurement of nanogram amounts arsenic in them possible.

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