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Improved Technique for the Determination of Uranium Minor Isotopes Concentrations in Microparticles by Using Secondary Ion Mass-Spectrometer in Multicollection Mode

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Traditional method of the analysis implies simultaneous measuring of secondary ion currents of isotopes $^{234}\text{U}^+$, $^{235}\text{U}^+$, $^{238}\text{U}^+$, ions with mass 236 amu ($^{236}\text{U}^+$ and $^{235}\text{UH}^+$) and hydride ions $^{238}\text{UH}^+$ by using mass-spectrometer Cameca IMS1280 in multicollection mode. Calculating of uranium isotopic composition is performed using the results of 40 successive measurements of those currents (cycles). Duration of each measurement is 8 seconds. Small amounts of uranium minor isotopes are limitation for precise determination of their concentrations. To prevent the damage of the secondary ions detector the intensity of ion current should be no more than 5×10^5 cps. This limitation does not allow to set higher primary ion current for the increasing of minor uranium isotopes ions emission because of the signal of ions $^{238}\text{U}^+$ gets too high.

New technique is developed to improve the accuracy of determination of uranium minor isotopes concentrations. Process of measurement is divided on two steps. First step is a measurement of ion currents during 20 cycles by five detectors. The second step implies the elimination of ions $^{238}\text{U}^+$ hitting to the detector and 10 times increasing of primary ion current.

The ratio $^{235}\text{U}/^{238}\text{U}$ is calculated from the first step results, so uncertainty of determination of this value is 1.4 times bigger than with duration of 40 cycles of the measurement. The ratios $^{234}\text{U}/^{235}\text{U}$ and $^{236}\text{U}/^{235}\text{U}$ are calculated during the second step. This technique allows to determine content of ^{234}U and ^{236}U with 3 and 5 times less uncertainties respectively, but with different degree of the sputtering particles. Moreover the duration of each cycle was set less (1 second) to use data more efficient. The technique accordingly with every second counting provides uncertainty of determination ^{236}U concentration 4 times less than traditional method at the same degree of sputtering particles.

Country or International Organization

Russian Federation

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