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Cross section measurement of deuteron induced nuclear reactions on Ge up to 50 MeV: Study of possible production routes for 74As and 77As radionuclides

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The radionuclides 71As, 72As and 74As have decay properties that are favorable for use in PET investigations, while the heavier isotopes 76As and 77As could potentially be used for tumor therapy. Due to their longer half-lives the compounds labeled with these 5 radionuclides can be used for studying of long-term biological phenomena. Studying antibodies, which usually have a long biological half life and do not reach optimal target to background selectivity for several days, could be one of their applications.
The cross sections of nuclear reactions induced by deuteron particles on natural germanium targets were investigated by the activation method using stacked target irradiation and standard high resolution gamma spectrometry. Targets were natural germanium deposits with nominal thickness of about 2 micrometers, vacuum evaporated onto 25 micron thick polyimide (kapton) foils. The stack was composed of 26 kapton-Ge-Ge-kapton sandwich targets interleaved with 26 aluminium and 26 titanium foils (nominal 150 and 11 micrometers thickness respectively). The Al foils served as monitors and at the same time energy degrader in the high energy part of the stack while the Ti foils served as monitors in the low energy part of the stack. The irradiation was done with a 50 MeV deuteron beam of about 50 nA for about 1 hour. Activation cross sections were determined for production of the radionuclides 70,71,72,73,74,76As, 69,75,77Ge and 66,67,68,72,73Ga. The deduced experimental cross sections were compared to the results of theoretical calculations taken from the TENDL-2013 data library based on the TALYS computer code. The experimental data published earlier were collected and critically compared to our new results. Thick target yields were deduced from the experimental cross sections and were compared with literature data. The possible production routes of the most interesting arsenic radionuclides (77As and 74As) are discussed.

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