

Experimental studies of the $^{232}\text{Th} + ^{48}\text{Ca} \rightarrow ^{280}\text{Ds}$ and $^{238}\text{U} + ^{40}\text{Ar} \rightarrow ^{278}\text{Ds}$ reactions: New isotopes ^{268}Sg , ^{272}Hs , ^{276}Ds , and ^{275}Ds .

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The $^{232}\text{Th} + ^{48}\text{Ca}$ reaction has been studied at the gas-filled separator DGFRS-2 online to the cyclotron DC280 at the SHE Factory at JINR. At three low ^{48}Ca energies, three new even-even nuclides were synthesized for the first time: a spontaneously fissioning (SF) ^{268}Sg with the half-life $T_{SF} = 13$ s; an alpha-decaying ^{272}Hs with $T = 0.16$ s and $E = 9.63 \pm 0.02$ MeV; and ^{276}Ds with $T_{1/2} = 0.15$ ms, $E = 10.75 \pm 0.03$ MeV, and an SF branch of 57%. The decay properties of these nuclei are in agreement with the systematics of experimental partial half-lives and alpha-decay energies of heavy known nuclei, as well as spontaneous-fission half-lives. The cross sections of the 4n-evaporation channel of 0.07 pb, 0.7 pb, and 0.11 pb were measured at 231, 238, and 251 MeV, respectively. At two higher projectile energies of 251 and 257 MeV, new isotope ^{275}Ds with the half-life of 0.43 ms and alpha-particle energy of 11.20(0.02) MeV was synthesized in the ^{48}Ca -induced reaction with actinide nucleus and identified by measuring correlated alpha decays ending in known nuclei. The $^{238}\text{U} + ^{40}\text{Ar}$ reaction was studied at 212 MeV resulting in observation of ^{273}Ds . The decay properties of nuclei originating from ^{273}Ds and ^{275}Ds are compared with theoretical calculations and decay schemes are proposed. The cross sections of the $^{232}\text{Th}(^{48}\text{Ca},5n)^{275}\text{Ds}$ reaction of 0.11 pb and 0.34 pb were measured at excitation energies of the ^{280}Ds compound nucleus $E = 51$ and 56 MeV, respectively. *The cross section of the 5n-evaporation channel of the $^{238}\text{U} + ^{40}\text{Ar}$ reaction at $E = 49$ MeV of 0.18 pb turned out to be comparable to that for ^{275}Ds at close excitation energy.*

For the first time since 1983, when the first experiments on the synthesis of Ds isotopes in direct reactions of ^{40}Ar , ^{48}Ca with isotopes of actinide elements (^{232}Th , $^{235,236,238}\text{U}$) were carried out, the reaction cross section was measured, which turned out to be an order of magnitude smaller than the cross section of the $^{226}\text{Ra}(^{48}\text{Ca},4n)^{270}\text{Hs}$ reaction. When moving to heavier elements ($Z > 110$), the cross section increases, reaching a maximum value for elements 114-115, and then decreases by about 30 times for element 118. Such variation is in full agreement with theoretical models predicting shells at $Z=108$, $N=162$ and $Z=114$, $N=184$.

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