SES10-2010-000088

Abstract for an Invited Paper
for the SES10 Meeting of
the American Physical Society

Synthesis of a new element with Z=117[1]

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The synthesis of new elements with neutron number (N) approaching 184 provide important tests of nuclear structure models used to predict closed spherical shells in the heaviest elements. Earlier, elements with Z=113-116, and 118 were synthesized in reactions of ^{48}Ca with actinide targets at JINR. The synthesis of previously unknown Z=117 can provide additional crucial tests of the shell structure near the predicted Island of Stability with N=184. Here we report the synthesis of ^{293,294}117 (N=176,177) in the ^{48}Ca + ^{249}Bk 4n and 3n reactions. The ^{249}Bk was produced at ORNL in the High Flux Isotope Reactor and chemically separated at the Radiochemical Engineering Development Center at ORNL. Six arc-shaped targets of 0.31 mg/cm^2 of ^{249}Bk were made at the Research Institute of Atomic Reactors (Dimitrovgrad). The experiments were performed employing the Dubna Gas-Filled Recoil Separator and the heavy-ion cyclotron U-400 at JINR, Russia. Separated evaporation residues were registered by a time-of-fight system and implanted in a 4 cm x 12 cm Si-detector array with 12 vertical position-sensitive strips surrounded by eight 4 cm x 4 cm side detectors. Irradiation at 252 MeV for 70 days starting July 27, with a total beam dose of 2.4 x 10^{19} yielded five position-correlated ($\leq$1.2mm) decay chains of 3 α's followed by spontaneous fission. These were assigned to ^{293}117 produced in the 4n reaction. At a ^{48}Ca energy of 247 MeV a new decay chain was detected involving six consecutive α-decays and ending in SF and assigned to ^{294}117 (3n channel). The daughters of ^{293,294}117 have one or two more neutrons than previously observed isotopes and have much longer half-lives. The decays of the eleven newly identified isotopes expand substantially our knowledge of odd-Z nuclei of the most neutron-rich isotopes of elements 105 to 117. These nuclei display increasing stability with increase in neutron number to strongly support the island of stability. Their longer half lives open up further studies of the chemistry of super-heavy elements and their place in the Periodic Table.

[1]For the Joint Institute for Nuclear Research, Oak Ridge National Lab, Vanderbilt U, Lawrence Livermore National Lab, Research Institute of Atomic Reactors, and U. Nevada LV collaboration.