Shell evolution in neutron-rich Te isotopes beyond doubly magic ^{132}Sn

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Within the context of the shell model, the nuclear structure is understood in terms of the shell orbital excitation across a large shell gap. In particular, the neutron-rich nuclei with a few valence nucleons at and near the doubly magic nuclei such as ^{132}Sn always attract attention for testing the various nuclear models in view of the rapidly changing nuclear structure with neutron numbers[1–3]. In this respect, Sb and Te isotopes, with one and two protons outside the Z=50 proton shell closure respectively, form an interesting set of nuclei to study the evolution of the nuclear structure beyond the Z=50 and N=82 shell closures. This work aims at determining the internal structures of the neutron-rich Sb and Te nuclei and observing the intrinsic nature of the nuclei such as isomerism, shape transition, and dynamic or static deformation.

The nuclei to be investigated were produced and isotope-separated with BigRIPS at the RIBF facility by the in-flight fission of a ^{238}U beam on a ^{9}Be production target at 345 MeV/nucleon. Measurements were focused on identification of $E(2^+)$ and/or $E(4^+)$ in even-even $^{138-140}$Te for investigating the ^{132}Sn core shell evolution and search for level scheme in the nuclei of interest to study the single-particle and collective features based on the β-decay level scheme. Particle identification was made by BigRIPS on the basis of the $B\rho$-ΔE-TOF method[4]. Further, subsequent β decays from the reaction products were detected after the Sb secondary beam was implanted into the active stopper, WAS^{3}ABi[5] with the EURICA array in its stopped-beam configuration[6].

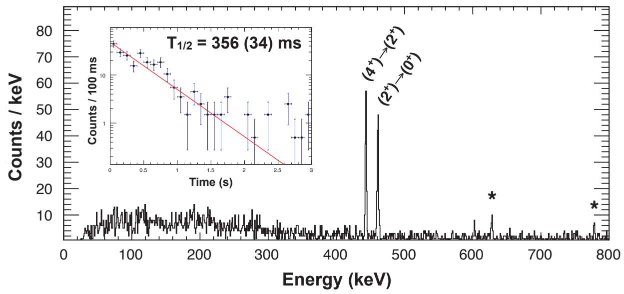

Fig. 1. Energy spectrum for β-delayed γ-decay associated with ^{138}Sb obtained by coincidence gates on lower transitions in ^{138}Te. Spectral lines marked by asterisks are newly identified γ rays in this work. The inset shows a decay curve for the β-decay of ^{138}Sb.

In the present experiment, we observed, for the first time, the β-delayed γ decay for ^{138}Sb as an example in Fig. 1. The deduced β-decay half-life for ^{138}Sb agrees well with previously reported value[7], while the half-life of ^{140}Sb needs more careful analysis to draw a conclusion. We found two new excited states above the known (4^+) state in ^{138}Te and one candidate excited state in ^{140}Te. We expect that this newly found spectroscopic information on excited states will provide crucial information on shell evolution of neutron-rich Te isotopes and pairing interaction around N=82 shell closure. Further analysis is in progress.

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