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Gamma-ray spectroscopy of heavy-actinide and transactinide nuclei: toward more neutron-rich and heavier nuclei

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Gamma-ray spectroscopy of heavy-actinide and transactinide nuclei is extremely difficult because of their very small production cross sections and severe backgrounds mainly arising from fission channel. Recently, some experimental approaches have overcome these difficulties, and opened a door to detailed nuclear structure studies for such heavy nuclei. For example, unsafe Coulomb excitation experiments with actinide targets and GAMMASPHERE successfully studied high-spin states in heavy actinide nuclei up to Cm [1]. In-beam gamma-ray spectroscopy with a recoil-decay tagging technique using recoil separators and cold-fusion reactions extended the frontier of gamma-ray spectroscopy up to No isotopes [2]. An isomer-gamma coincidence technique using recoil separators is also very powerful to observe excited states in heavier nuclei than Fm [2], and alpha-gamma coincidence measurements using recoil separators have achieved decay studies of Rf and Sg isotopes [3]. The latter three experiments utilize recoil separators, which restricts available production reactions to cold-fusion reactions that can produce nuclei only in the neutron-deficient side.
To study more neutron-rich and heavier nuclei, we have performed two kinds of experiments at the JAEA tandem accelerator facility; one is alpha-gamma coincidence spectroscopy using a gas-jet transport technique and hot-fusion reactions with actinide targets, and the other is in-beam gamma-ray spectroscopy using transfer reactions with heavy actinide targets. Alpha-coincident gamma rays were successfully measured in alpha decays of 255,257,259No and 261Rf, and spin-parities and neutron single-particle configurations of their ground states as well as excited states in their daughter nuclei were identified [4]. This is the first spin-parity assignments for the nuclei in the Z > 101 and N > 153 region. In the in-beam gamma-ray spectroscopy, ground-state bands of neutron-rich 236Th, 240,242U, 246Pu, and 250Cm nuclei were established for the first time, and excited states in some odd-mass nuclei were also established [5]. In this talk, some interesting results and future plans of our experiments will be presented.

References
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