Prospects of investigation of multinucleon transfer reactions.

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Earlier successful investigations of heavy actinide nuclei produced in multi-nucleon transfer (MNT) reactions of actinide targets with various projectiles from O up to U suggest that unknown neutron-rich or neutron-deficient heavy and superheavy nuclei (SHN) might be produced using MNT reactions. This topic arose because the current method of heavy-ion fusion reactions has almost reached its limits in producing heavy and super-heavy isotopes on the neutron-rich side of the stability line. The other alternative, the application of neutron rich radioactive ion beams do presently not help to address the issue because of the very small beam intensities ($< 10^9$ ions/s).

Recently, we observed several new isotopes with proton numbers $Z \geq 92$ in low-energy collisions of $^{48}Ca + ^{248}Cm$. The peculiarity is that the nuclei were produced in deep inelastic multinucleon transfer reactions, a method which is presently discussed as a possible new pathway to enter so far unknown regions in the upper part of the nuclide chart. For separation of the transfer products we used a velocity filter, the Separator for Heavy Ion reaction Products SHIP at GSI. The resulting strong background suppression allowed us to detect nuclei with cross-sections down to the sub nanobarn scale. The isotope identification was performed via the alpha decay chains of the nuclei in the focal plane of SHIP. Beside the new isotopes we identified about 100 further target-like transfer products with proton numbers up to $Z = 102$ and determined their cross-sections.

First experimental tests for separation of the transfer products with the use of velocity filter, the Separator for Heavy ELement Spectroscopy SHELS at FLNR JINR, Dubna was performed at year 2018.

Our results are discussed together with previous measurements, and perspectives will be given for the application of multinucleon transfer reactions to produce new heavy and super heavy isotopes.

The project of new kinematic separator dedicated for the MNT reactions studies is discussed. We plan to implement a project together with modernization of U400 cyclotron.