Production of exotic nuclei in quasifission type reactions

N.V. Antonenko[1]
[1] *Bogoliubov Laboratory of Theoretical Physics,*
Joint Institute for Nuclear Research 141980 Dubna, Russia

The multinucleon transfer reactions and quasifission-type reactions are actively discussed to produce exotic nuclei. We demonstrate the possibilities for producing neutron-rich isotopes ^{82,84,86}Zn and ^{86,88,90,92}Ge in the reactions ^{48}Ca+^{238}U, ^{244}Pu at incident energies near the Coulomb barrier. The dynamics of the binary reaction is considered as the diffusive multinucleon transfer between the interacting nuclei in the collisions when the excitation energy of the produced exotic isotope is lower than the threshold for the neutron emission. The calculated results indicate that the Q_{gg} values influence the production cross sections because of the binary character of the reaction. The predicted cross sections are on the level (0.1-160) pb. The current experimental technology allows us to reach the cross section of 1 pb in about one week of beam time.
The quasifission reactions ^{48}Ca+^{244,246,248}Cm at beam energies close to the corresponding Coulomb barriers, one can produce the new isotopes of superheavies with $Z = 103 - 108$, which undergo fission (the fission width is much larger than the neutron emission width). The calculated results indicate that these quasifission reactions provide a very efficient tool for the study of new isotopes of superheavy nuclei that fill the gap between the isotopes produced in the cold and hot complete fusion reactions. The predicted cross sections of the fission, which follow multinucleon transfer are on the level (100 nb-100 μb). One can propose the experiments on the quasiternary fission in which the fission fragment mass and the angular distributions in coincidence with the complementary transfer products, which range from O to P ions can be measured. Since the fission barrier of the superheavy nuclei is mainly determined by the shell correction in the ground state, in these experiments, one can study the dependence of the value of shell correction on the average excitation energy, which is easily calculated, and (Z, N) of the fissioning nucleus.
Possibilities of production of new isotopes of superheavy nuclei with charge numbers $104 - 108$ in asymmetry-exit-channel quasifission reactions are discussed. The optimal conditions for the synthesis are suggested in this type of reactions.