Fusion and transfer reactions with radioactive ^{6}He beams

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Excitation functions were measured for fusion followed by the evaporation of neutrons in the reactions ^{206}Pb(^{6}He,2n)^{210}Po and ^{197}Au(^{6}He,xn)$^{203-xn}$Tl, where x=2-7, as well as for the transfer reactions on a ^{197}Au target with the formation of the ^{196}Au, ^{198}Au and ^{199}Au isotopes. The stacked foil technique was used and the identification of the reaction products was done by their radioactive γ- or α-decay. The experiment was carried out at the Dubna Radioactive Ion Beams (DRIBs) complex of FLNR, JINR [1]. The ^{6}Í å beam intensity was about $2\cdot10^{7}$ pps, the maximum energy being 60.3±0.4 MeV.

The experimental data for the fusion reaction with the evaporation of 3 to 7 neutrons is are in agreement with statistical model calculations [2]. In both reactions for the fusion channel with the evaporation of two neutrons, a significant increase in the cross section was observed below the Coulomb barrier. The analysis of the data in the framework of the statistical model for the decay of excited nuclei, which took into account the sequential fusion of ^{6}He with ^{206}Pb has shown good agreement between the experimental and the calculated values of the cross sections for the case of sub-Coulomb-barrier fusion in the ^{206}Pb + ^{6}He reaction [3].

In the transfer reactions, an unusual increase was observed for the production of ^{198}Au, whereas only an upper limit of the cross section for the formation of ^{199}Au was obtained [2]. Different mechanisms are considered for the transfer reactions leading to different yields of the gold isotopes.

[1] Yu.Ts. Oganessian and G.G. Gulbekian. In: Proc. of the Int. Conf. “Nuclear Shells - 50 Years”, Dubna, Russia, 1999, Eds. Yu.Ts. Oganessian, W. von Oertzen and R. Kalpakchieva (World Scientific, Singapore, 2000) P. 61-75;
[2] Yu.E. Penionzhkevich *et al*., Preprint JINR E7-2005-106, Dubna 2005;
[3] V.I. Zagrebaev, Phys. Rev. C 67, 061601 (2003).