

Basic Distinctions between Cold- and Hot-Fusion Reactions in the Synthesis of Superheavy Elements

A. K. Nasirov^{1),2)*}, A. I. Muminov^{2)**}, G. Giardina^{3),4),5)***}, and G. Mandaglio^{3),4),5)****}

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Abstract—Superheavy elements (SHE) of charge number in the range of $Z = 106–112$ were synthesized in so-called cold-fusion reactions. The smallness of the excitation energy of compound nuclei is the main advantage of cold-fusion reactions. However, the synthesis of SHEs of charge number in the region of $Z \geq 112$ is strongly complicated in cold-fusion reactions by a sharp decrease in the cross section of a compound nucleus formation in the entrance channel because of superiority of quasifission in the competition with complete fusion. Two favorable circumstances contributed to the success of the experiments aimed at the synthesis of the $Z = 113–118$ elements and performed at the Laboratory of Nuclear Reactions at the Joint Institute for Nuclear Research: large cross sections for the production of a compound nucleus, which are characteristic of hot-fusion reactions, and an increase in the fission barrier for nuclei toward the stability island. The factor that complicates the formation of a compound nucleus in cold-fusion reactions is discussed.

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