Alpha decay and cluster radioactivity within dinuclear system model

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The model for the description of cluster decay of cold and hot even-even nuclei, where the quantum oscillations in charge asymmetry coordinate defines the value of spectroscopic factor, is presented. The possible rotations in the formed cluster configuration are taken into consideration in the calculation of penetrability of the Coulomb barrier in the relative distance between the clusters. Finally, the dependence of half-life on the temperature $T$ is $t(T) = \frac{\sum_n t_n \exp[-E_n/T]}{\sum_n \exp[-E_n/T]}$, where $E_n$ is the eigenvalue of the Schrödinger equation in the charge asymmetry coordinate and $t_n$ is the half-life of cluster emission for each $E_n$. The known experimental data on cluster radioactivity from the ground state of nuclei are described. The half-lives of cluster emission from neutron-deficient actinides and medium-mass nuclei and the dependence of half-life on the isotopic composition of the parent nucleus are predicted [1].

The theoretical assumption of the charge asymmetry vibrations can be experimentally checked by measuring the probabilities of the emission of different clusters as functions of excitation energy. Irregularities in the increase of the emission of various clusters with excitation reflect the charge asymmetry-vibrational states. The optimal excitation energies for the emission of different clusters are predicted.

In the case of alpha-decay of cold mother nucleus with spin $I \neq 0$ the calculations of half-lives are performed. The difference between decays from odd and even parity states is shown. The possibility of experimental observation of alpha-decays from high-spin levels $I \approx 15 - 20$ of several neutron-deficient nuclei is demonstrated.