Cluster decay half-lives in transition metal region using RMF theory

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Abstract

In the present work, we have studied the alpha-like clusters (^{8}Be, ^{12}C, ^{16}O, ^{20}Ne, and ^{24}Mg) decay half-lives in the transition metal region for ($^{156-166}$Hf, $^{158-172}$W, $^{160-174}$Os, $^{166-180}$Pt, and $^{170-182}$Hg) nuclei. These half-lives have been calculated using the shape parametrization model of cluster decay in conjunction with the relativistic mean-field [1] (RMF) model with the NL3* parameter set. Thus calculated cluster decay half-lives are also compared with the half-lives computed using the latest empirical relations, namely Universal decay law (UDL) [2] and the Scaling Law given by Horoi *et al* [3]. From the calculated results, it has been observed that in the transition metal region, half-lives are minimum at $N_d = 82$ (N_d is the neutron number of the daughter nuclei), which is a magic number and shell effect at $N_d = 82$. Cluster emissions leading to the isotopes with N_d = 82 are easier to measure than those of non-α-like cases due to the large Q values in α-like cluster emission processes. Further, the Geiger-Nuttal [4] plots of half-lives showing Q dependence for different alpha-like clusters from various CR emitters that have been plotted are found to vary linearly.

References

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