LETTERS TO THE EDITOR

APPLICATION OF FERMI'S ATOMIC MASS FORMULA TO THE ESTIMATION OF ALPHA-DISINTEGRATION ENERGY IN THE RARE EARTH REGION

Several attempts have been made to set up a semi-empirical atomic mass-formula for the estimation of atomic mass M (Z, A) of an element of mass number A and atomic number Z. The mass formulas developed by Bohr and Wheeler[1] and by Bethe-Weizsäcker[2] have been extremely useful in explaining and predicting many of the properties of the nuclei. But their inadequacy in their application to radioactive decay has been well established by many workers. The Fermi-Weizsäcker formula with Stern's correction term,[4] though satisfactory in nuclides for $A \geqslant 212$ for alpha decay energy, has been shown to be inadequate in rare earth region.[5] The systematics of alpha decay properties have been well defined by Perlman, Ghiorso and Seaborg[6] and the properties of possible alpha-emitters have been predicted.

Recent mass measurements by Duckworth[7] and their comparison with the estimated masses have helped to determine a correction-term which fits in well with the experimental results. The calculated masses have been compared with the observed ones in Table I below for $Z = 72$, 60, 58, 56, 52. From the study of variation of atomic mass with A and Z, the correction to the atomic mass has been estimated to be

$$\Delta m = 0{\cdot}0185 - 2\,[kA^{1{\cdot}2} - k_1 Z^{1{\cdot}5}] \text{ M.U.} \quad (1)$$

where $k = 0{\cdot}0002$ and $k_1 = 0{\cdot}00014$. The masses calculated using this correction-term are in better agreement with experimental results.

Let us consider an alpha-emitter of atomic mass M(Z, A) and the daughter atom of mass M(Z − 2, A − 4). The alpha disintegration energy is given by