Answer on Question #51448, Physics, Solid State Physics

With the help of the binding energy curve for nuclei, explain main characteristics of elements and the phenomenon of nuclear fusion and fission.

Answer:

The nucleons are bound together in a nucleus and energy must be supplied to the nucleus to separate the constituent nucleons to large distances. The amount of energy needed to do this is called the binding energy of the nucleus. Thus, the binding energy of a nucleus is the energy required to take its nucleons away from one another.

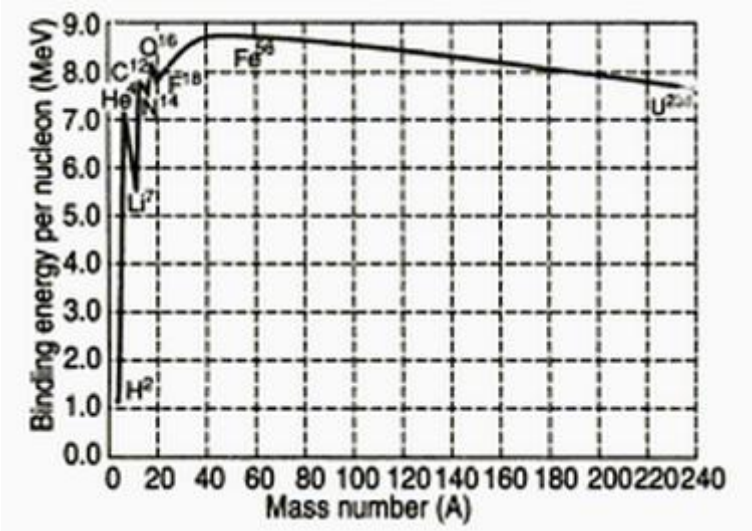

Fig.1

The binding energy of a nucleus is generally expressed as binding energy per nucleon. It is a measure of the stability of nucleus. Higher the binding energy per nucleon, more stable is the nucleus.

A graph between the binding energy per nucleon and the mass number of nuclei is called the binding energy curve. This is shown in the Fig.1

Fission is the splitting of a nucleus that releases free neutrons and lighter nuclei. The fission of heavy elements is highly exothermic which releases about 200 million eV compared to burning coal which only gives a few eV. The amount of energy released during nuclear fission is millions of times more efficient per mass than that of coal considering only 0.1 percent of the original nuclei is converted to energy. Daughter nucleus, energy, and particles such as neutrons are released as a result of the reaction. The particles released can then react with other radioactive materials which in turn will release daughter nucleus and more particles as a result, and so on.

Nuclear fusion is the joining of two nuclei to form a heavier nuclei. The reaction is followed either by a release or absorption of energy. Fusion of nuclei with lower mass than iron releases energy while fusion of nuclei heavier than iron generally absorbs energy. This phenomenon is known as iron peak. The opposite occurs with nuclear fission.