Pg-II Nuclear chemistry

Concept of Critical Mass in the Fission Chain Reaction

Nuclear fission reaction is accompanied by the release of enormous amount of Energy as a result of capture of a neutron and further emission of two or more neutrons. The neutrons thus released may cause fission of other nuclei of ^{235}U thereby setting up a Nuclear chain reaction.

Hence Once started, the fission process would be self Sustaining accompanied by a continuous release of energy.

$$^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{236}_{92}U^{*} \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n$$

(excited)

nuclear fission reaction.

— To secure a self sustaining chain reaction in fission reaction, it is essential that the number of neutrons produced in a fission process must be at least equal to the number of neutrons absorbed in both fission and non fission reaction plus the number of neutrons which escape from the System →

This object is achieved by decreasing The ratio of Area of cross section to Volume (with increase in size, the increase in surface area is less than the increase in volume)

Since neutron are produced throughout the whole volume but their escape occurs only at the surface, hence the decrease in surface area of cross section, the number of neutrons which escape from the system decreases

Thus the size of fissionable material whose surface permits the escape of neutrons to such an extent that at least one neutron is positively left behind per fission is called critical size and corresponding mass of material is called critical mass.

Thus the mass of the fissionable material is less than its critical mass, nuclear fission would not be sustained. i.e. more than critical mass is needed for fission to be sustained