Examination of Weisskopf-Ewing Approximation for the Determination of (n,α) Reaction Cross-Sections

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Out of the many neutron-induced reactions that take place inside a fusion reactor, the ones that produce gaseous elements like hydrogen and helium are of utmost importance for the study of the structural integrity of reactor materials. Hydrogen and helium gas production occurs mainly through (n,xp) and (n,xα) reactions. These reactions are induced on the different walls of the fusion reactor mainly the first wall, structural, blanket materials, and others. The production of hydrogen and helium leads to other processes such as atomic displacements and transmutations which can produce microstructural defects and modify the physical properties of the materials. The materials suitable for the reactor structures are stainless steel with Cr, Fe, and Ni as main constituents in SS316(LN)-IG content of (Fe ~ 65%, Ni ~ 12%, Cr ~ 17%). As the neutrons continuously coming from plasma interact with the various walls of the reactor made up of SS, there will be the generation of various long-lived radio-nuclides like ^{55}Fe ($T_{1/2}$= 2.737 years), ^{59}Ni ($T_{1/2}$ = 7.6×10^4 years) and many others inside reactor environment. The neutrons coming from plasma interacts with various long-lived radionuclides already generated in the reactor environment during its operation, such types of reactions are called second generation reaction. The cross-sections of the neutron-induced reaction of various radionuclides are not measured and studied till now. So, there is a large gap in the nuclear data library. In the past years, the surrogate method has been used for cross-section measurement. The surrogate method assumes that the reaction takes place through the compound nucleus mechanism only, but at high energies, pre-equilibrium and direct reaction channels also occur. The present study explores the surrogate reaction method by determining the validity of Weisskopf-Ewing approximation for (n,α) reaction on n + ^{56}Fe reaction.