Neutron induced cross-section for Sn isotopes of interest in fusion reactor technology

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Introduction

There is a variety of materials (Breeder, neutron multiplier, coolants, shielding, magnets, and insulators) present in the ITER device. Neutron induced cross-section data must be provided for the variety of nuclides constituting the materials to be used in fusion device. Magnet system of ITER is the largest and most integrated superconducting system. The ITER's magnetic field system comprises three giant superconducting systems : The Toroidal magnetic field system(TF) , The Poloidal magnetic field system(PF) , and the central solenoid (CS) , these are also called or represents the backbone of the tokomak. Superconducting magnets are able to carry higher current and produce stronger magnetic field. They also consume less power and are cheaper to operate. Ten thousand tons of magnets is going to produce the magnetic field that will initiate, confine shape and control the ITER plasma [1].

Motivation

There is a need of nuclear data for magnetic materials of ITER project. Most technically challenging raw magnetic materials – the Nb_3Sn superconducting strands used in ITER. It is necessary to have the exact information of the cross section for different neutron induced reactions for this material [6]. It is found from the Exchange Format (EXFOR) database that there is lack of measured cross-section data of (n,p) and (n,2n) reactions for Sn.

Calculation

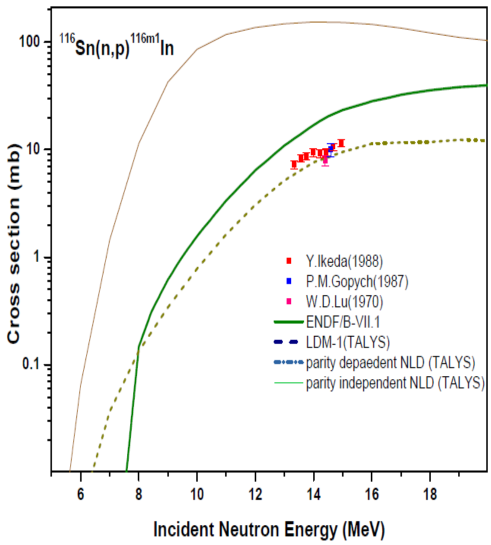
The present study highlights the discrepancy and scarcity of the available experimental data for (n,p) and (n,2n) reactions cross-section of stable Sn isotopes, and our effort to make a thorough study on that using systematics given by different authors and optimized calculations of cross-section using nuclear reaction modular code TALYS-1.6 and EMPIRE.

Results and Discussion

In the present paper the different aspects of determination of cross section for (n,p) and (n,2n) for stable isotopes of Sn has been compared, such as systematics and nuclear modular codes: TALYS – 1.6 [3] and EMPIRE – 3.2.2 [2]. The experimental data available in EXFOR data base are taken as reference for the validation. In order to get the nearest cross section value at energy 14 MeV, different input models of the nuclear modular codes were tested. Cross section data evaluated using the best suitable model for the energy range 1 to 20 MeV. Neutron induced reaction cross-section of 116Sn(n,p) (n,a) (n,2n) have been calculated from threshold to 20 MeV. The aim of the present paper is to present the current status of 116Sn(n,p)116 mIn, 116Sn(n,a)113mCd, 116Sn(n,2n)115Sn and their needs in the fusion reactor technology [1]. 116Sn is the stable isotopes of Tin (Sn).

Conclusion

The computed cross-sections together with the experimental data taken from EXFOR data files and evaluated data libraries were plotted for all cases. Fig. 1. Shows the illustrative case of 116Sn(n,p).



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2. [6] http://www-nds.iaea.org/exfor

Reaction	EXFOR data	Remark
116Sn(n,α)113mCd	No data	Long-lived (13.7 year) product Cd-113m
116(n,2n)115Sn	No data	3-step production of In-113 (1.658h), 3 step production of Sn-113 (115.09 d)
116Sn(n,p)116In		
116Sn(n,p)116In(m1) (54.29 min)		
116Sn(n,p)116In (m2)		