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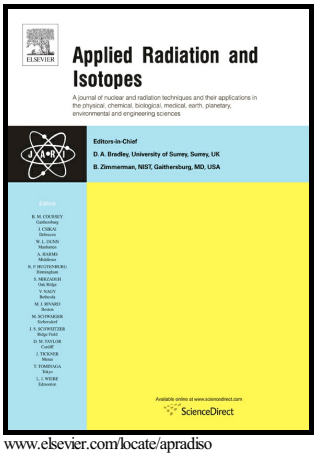

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A novel design of beam shaping assembly to use D-T neutron generator for BNCT

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Abstract

In order to use 14.1 MeV neutrons produced by D-T neutron generators, two special and novel Beam Shaping Assemblies (BSA), including multi-layer and hexagonal lattice have been suggested and the effect of them has been investigated by MCNP4C Monte Carlo code. The results show that the proposed BSA can provide the qualified epithermal neutron beam for BNCT. The final epithermal neutron flux is about 6e9 n/cm2.s. The final proposed BSA has some different advantages: 1) it consists of usual and well-known materials (pb, Al, Fluental and Cd); 2) it has a simple geometry; 3) it does not need any additional gamma filter; 4) it can provide high flux of epithermal neutrons. As this type of neutron source is under development in the world, it seems that they can be used clinically in a hospital considering the proposed BSA.

Keywords:BNCT; D-T neutron generator; MCNP4C Monte Carlo code, BSA

1. Introduction

Boron Neutron Capture Therapy (BNCT) is a modern method of radiation therapy based on the 10B(n,α)7Li reaction. In this method a boron-containing compound is first infused into a peripheral vein, following which the compound accumulates in tumor tissue, the tumor is subsequently irradiated with neutrons.7Li and α particles as a result from a 10B neutron capture reaction release their energy within a tumor cells and destroy them (Sauerwein, 2012, Barth 2012).

The qualified neutron beam for BNCT is determined by the International Atomic Energy Agency (IAEA). Table 1 shows the recommended parameters for the therapeutic neutron beam (IAEA-TECDOC-1223, 2001). In order to provide such a beam, a special Beam Shaping Assembly (BSA) must be designed based on the neutron source specifications. A typical BSA includes moderator, reflector, collimator, thermal neutron filter, and gamma filter. The role of the moderator is to moderate fast neutrons to epithermal neutrons and the role of the reflector is to prevent neutron leakage from the beam line. In common BSA, the reflector is considered as a layer which covers the sides of the moderator materials as shown in fig. 1 (Kasesaz, 2013).