Liquid Li based neutron source for BNCT and science application

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An accelerator based neutron source is important for BNCT and scientific applications. Lithium (Li) is a suitable target material to generate low energy neutrons through ^{7}Li(p,n)^{7}Be reaction. Owing to lower energy nature of neutron generation, this system produces less gamma-rays in moderater and shield. In our design, Li target consists of liquid metal free surface flow in vaccum with high beam power removal capability. Lower beam energy allows us to employ an electrostatic beam equipment. Neutrons of ~10^{13} n/sec will be generated with a beam current of 30 mA at around 2.5 MeV, corresponding to the energy of the first resonance of the reaction. As for collimator/moderator, polyethylene including boron and lead were used for neutron and gamma-ray shield, respectively. Neutrons were moderated with a pair of material having different moderation performance made of light and medium density material.

In 2013, after careful estimation on the basic design performance, experiments were carried out with using a dynamitron accelerator in Birmingham University with exported test equipments from Japan. As a result of the experiment, it was found that the neutron flux was collimated as designed by numerical calculation, and that gamma ray dose for a human body could be suppressed to a similar level to those at research reactors.

In the present design, Li target flows in a holizontal channel and beams come vertically downwards. Neutrons are tranported vertically and a patient is placed on a bed below the collimater. The switching ON and OFF of the beam is so easy and quick that simple interlocks of the beam will secure patients and practicians from radiation exposures and high voltage hazards. Since the lithium flow is containd in a vacuum channel covered with an additional wall and a thick radiation shield, containment of Li is very secure. The facility is constructed on an area of 17m x 17m with an electric demand of approximately 0.5MVA.

This facility will be constructed in two years, followd by comissioning and inspections for a year. After the completion pre-clinical experiments will be initiated by researchers of the dental surgery and cranial nerve surgery of the University.

In addition to this report, three presentations on the mock-up experiment and the experimental results on gamma-ray and neutron measurements are presented in the conference.