Performance Evaluation of Accelerator based BNCT system in Nagoya University

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An accelerator-based neutron source for BNCT has been developing with a combination of a sealed Li target and a DC accelerator (Dynamitron) in Nagoya University. Li is considered to be a suitable target material to generate low energy neutrons with high efficiency through a $^{7}Li(p,n)^{7}Be$ reaction, but to have some difficulties in target handling. To solve it by confining melted Li and radioactive ^{7}Be, we have developed the sealed Li target with a structure in which Li on the cooling base plate is covered with a Ti foil. The Dynamitron produces proton beams with the maximum energy of 2.8 MeV and the maximum current of 15 mA. In 2018, we have succeeded in the production of epi-thermal neutrons by irradiating proton beam of 2.8 MeV and 1mA on the sealed lithium target, and started non-clinical tests to evaluate the device performance as a medical equipment. As the first step, “In vitro” tests had been performed by using Human squamous cancer (SAS) cells.

SAS cells were soaked in a medium with the boron-phenylalanine (BPA) of 200 ppm over 24 hours before the neutron irradiation. The neutron flux had comparatively flat distribution in the radial direction of the BSA extraction port (12cm in dia.) and nine 0.6 mL tubes could be set in the irradiation area. Each tube contained a cell suspension of 5×10^{4} cells /0.5 mL and was set in an acrylic case dipped in a water phantom for neutron irradiation. Thermal neutron flux was measured in all batches to be about 0.5×10^{8} n/sec/cm^{2} at the proton current of 0.5mA by the Au activation method. Total dose was controlled by changing the neutron irradiation time from 10 to 40 minutes.

Colony assay was used to evaluate the dependence of the cell survival rate on the neutron and the gamma doses. In this presentation, we will report evaluation results of irradiation field and in vitro test to evaluate the present performance of the NAGOYA BNCT system.