BEAM PORT AND IRRADIATION CHAMBER OF THE REIKEN CYCLOTRON FOR BIOLOGICAL SAMPLES

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Since the energy of heavy ions of the RIKEN ring cyclotron(SSC) is lower than that of Bevalac of the Lawrence Berkeley Laboratory and higher than that of Unilac of the Gesellschaft fur Schwerionenforshung, charged particles of the SSC are expected to be convenient for the studies of biological effects of heavy ions having the intermediate energy without fragmentation.

The beam port for the biological researches is composed of an apparatus for making a homogenous irradiation field and a beam monitoring system. The apparatus for making the irradiation field, which can cover the size of a dish for cell culture with a diameter of 35 mm and the experimental tumor implanted on the laboratory animal, is composed of a whobbler scanning magnet, a beam scatterer and a slit. Since the materials and its thickness used for the scatterer are dependent on the sort and the energy of the beam, the scatterers with various materials and its thickness are set up with exchangable mechanics. The beam monitoring system is composed of a parallel plate avalanche counter(PPAC), a zinc sulfide monitor and a carbon foil monitor. The PPAC is used for both the beam profile monitoring and the precise measurement of the beam intensity especially for the particles with the large atomic number. The beam focusing is performed by monitoring the beam profile on the zinc sulfide monitor with a television camera. The carbon foil monitor is used for adjusting the beam current and measuring the beam intensity. Beam absorbers, a collimator, two ion chambers and an irradiation chamber in order are set up outside the irradiation window which locates on the end of the vacuum port.

The irradiation chamber must be constructed from materials which are not toxic to cell growth and which can be sterilized to prevent biological contaminations such as fungus to growth in medium. Therefore, only stainless steel, Teflon, or glass are used. The temperature of the chamber volume should be kept at 30-37°C for the optimal growth conditions. To investigate the synergistic action of hyperthermia and radiation, the temperature of the chamber should be adjusted in the range of 37-45°C with an accuracy better than ±0.05°C. To investigate the damage of nucleic acids and protein in the biological systems, the temperature must be kept below 4°C to prevent the repair of the damages during exposure if the biological samples to the beam. For these purpose, air at a desired temperature must be introduced into the irradiation chamber. To measure the oxygen enhancement ratio of the irradiated cells and test hypoxic radiosensitizers, the gas process is controlled and monitored by signals from the control room outside the irradiation room.