蛍光イオントラックを用いた重イオン計測と放射線生物学への応用

Application of fluorescent nuclear track detectors for heavy charged particle measurement and radiobiology experiment

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We have investigated the performance of an optical and non-destructive “fluorescent nuclear track detectors (FNTD)” as a possible spectroscopic technology for heavy charged particles. The technique uses aluminum oxide single crystals having aggregate oxygen vacancy defects and doped with magnesium (Al_2O_3:C,Mg). The spectroscopic capabilities were demonstrated for energetic heavy ions of LET (linear energy transfer) in water ranging from 1 to 730 keV/μm. The FNTD was found to be capable of distinguishing fragments from 290 MeV/n carbon ions with better charge resolution. The benefits of using FNTD include wide dynamic range of measured LET, large angular acceptance and ability to measure products of nuclear fragmentation reactions with topological branching ratios such as C → 3α and C → 2Li. Recently, we have tried to apply FNTD to radiobiology. The combination of FNTD and use of a confocal laser microscope may be used for simultaneous detection of the geometric position of ion tracks and cell images on a microscopic scale. Cells were cultured on the surface of FNTDs and then exposed to 5.1 MeV/n neon ions. The position of the ion tracks and the DNA double strand break regions, which were identified as fluorescent spots by immuno-staining against γ-H2AX were obtained simultaneously with the confocal laser microscope. The patterns of the γ-H2AX fluorescent spots coincided extremely well with the pattern of the ion tracks. This method will be useful not only to evaluate the number of ion traversals per cell nucleus and/or cytoplasm but to distinguish hit and non-hit cells in the cell population.