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# Calibration of Mini TEPC and Measurement of Lineal Energy in a Mixed Radiation Field Produced by Neutrons

**Authors :** I. C. Cho, W. H. Wen, H. Y. Tsai, T. C. Chao, C. J. Tung

**Abstract :** Tissue-equivalent proportional counter (TEPC) is a useful instrument used to measure radiation single-event energy depositions in a subcellular target volume. The quantity of measurements is the microdosimetric lineal energy, which determines the relative biological effectiveness, RBE, for radiation therapy or the radiation-weighting factor, WR, for radiation protection. TEPC is generally used in a mixed radiation field, where each component radiation has its own RBE or WR value. To reduce the pile-up effect during radiotherapy measurements, a miniature TEPC (mini TEPC) with cavity size in the order of 1 mm may be required. In the present work, a homemade mini TEPC with a cylindrical cavity of 1 mm in both the diameter and the height was constructed to measure the lineal energy spectrum of a mixed radiation field with high- and low-LET radiations. Instead of using external radiation beams to penetrate the detector wall, mixed radiation fields were produced by the interactions of neutrons with TEPC walls that contained small plugs of different materials, i.e. Li, B, A150, Cd and N. In all measurements, mini TEPC was placed at the beam port of the Tsing Hua Open-pool Reactor (THOR). Measurements were performed using the propane-based tissue-equivalent gas mixture, i.e. 55% C3H8, 39.6% CO2 and 5.4% N2 by partial pressures. The gas pressure of 422 torr was applied for the simulation of a 1 □m diameter biological site. The calibration of mini TEPC was performed using two marking points in the lineal energy spectrum, i.e. proton edge and electron edge. Measured spectra revealed high lineal energy (> 100 keV/□m) peaks due to neutron-capture products, medium lineal energy (10 – 100 keV/□m) peaks from hydrogen-recoil protons, and low lineal energy (< 10 keV/□m) peaks of reactor photons. For cases of Li and B plugs, the high lineal energy peaks were quite prominent. The medium lineal energy peaks were in the decreasing order of Li, Cd, N, A150, and B. The low lineal energy peaks were smaller compared to other peaks. This study demonstrated that internally produced mixed radiations from the interactions of neutrons with different plugs in the TEPC wall provided a useful approach for TEPC measurements of lineal energies.

**Keywords :** TEPC, lineal energy, microdosimetry, radiation quality
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