Density- normalized first Townsend ionization coefficients in a CH_4-based tissue-equivalent gas mixture

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ABSTRACT

Since 1950 methane-based tissue-equivalent gas (TEG) mixtures have been employed at low pressure in gaseous microdosimeters, such as tissue-equivalent proportional counters. Nevertheless, values of the first Townsend ionization coefficient (α) for these mixtures are scarce in the literature. In this work measurements of α as a function of the density-normalized electric field (E/N) were carried out in a methane-based TEG (CH_4 - 64.4%, CO_2 - 32.4% and N_2 - 3.2%) in the range 100-300Td. The values of α were obtained using the Pulsed Townsend Technique by measuring the current growth as a function of the electric field strength in a Resistive Plate Chamber structure. Because of the parallel plate geometry, the field is uniform in our setup. As far as the authors are aware, there is only one set of experimental data on α for CH_4-TEG published by Schmitz and Booz for reduced field strengths between 110V.cm^{-1}.torr^{-1} (≈ 315Td) and 1780V.cm^{-1}.torr^{-1} (≈ 5045Td). However, they employed a cylindrical proportional counter where α /p values were gathered from measurements of the gas gain resulting from an interval of electric field strengths. Because there are no data on α in methane-based TEG in the E/N range herein investigated, our results were compared with those expected from Magboltz simulations. Good agreement was found between experimental and simulated values of density-normalized α.