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4.1 Ion Cluster Spectra at Nanometre Track Created by Alpha Particles

by S.Pszona, J.Kula and S.Marjańska

The interaction of charged particles with matter over a nanometre distance is of interest for biological science (DNA structure). For such "nanometre" sites, instead of deposited energy it is more meaningful to focus the attention on the distribution of the number of ionisations (cluster of ions) within such structures. The distribution of the ion clusters, occurring at the nanometre track length irradiated by alpha particles in the set up called JET COUNTER was measured. The description of Jet Counter has been given in previous Annual Report (1) as well as in (2-3).

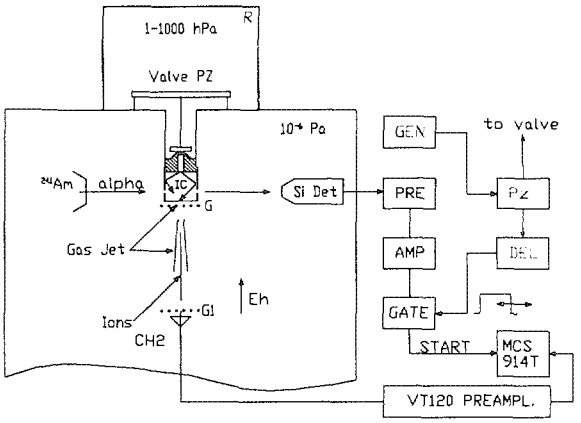

Fig. 1 The block diagram of set up for ion cluster measurements

Fig. 1 shows the block diagram of set up for ion cluster measurements for alpha particles of ^{241} Am source. Only these ionisation events created in an interaction chamber by single alpha particle, which are in coincidence with gas jet are selected by the gate GATE initiate the multiscaler (MCS) 914T. The input signal to MCS is formed by an electron multiplier, CH2, (operated in a mode for positive ion detection) then amplified by fast preamplifier VT 120. The MCS type 914T ORTEC, has 10 ns resolution and is programmed to run only through 200 μs i.e. time necessary to allow all ions created in interaction chamber to reach the detector CH2. Applying the MCS, the time of flight pattern of ions is simultaneously recorded. The registered number of counts is read out between the consecutive gas pulses. A number of counts spectrum for a given diameter of nitrogen gas layer, for 1000 alphas in coincidence with gas jet is collected. To convert the measured count number spectra, to the true number of ions spectra, the efficiency of a CH2 detector to single ions has been determined in a separate experiment (see this Annual Report) The ion cluster spectra for 3.6, 7.4 and 10 nm are shown on Fig.2. Two maxima can be seen i.e. first one for clusters containing between 2 and 3 counts and another around a cluster of 7 counts. The existence of two maxima for 10 nm of alpha particle track can be explained by an assumption that the first maximum is due to the delta electrons only.

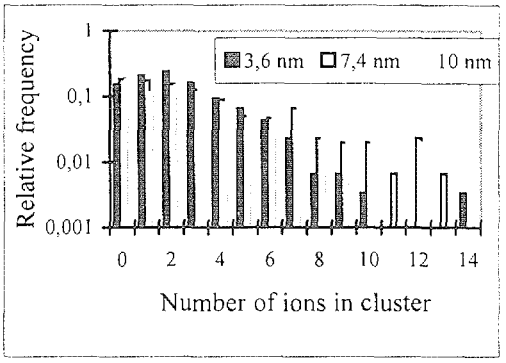

Fig.2 Relative frequency of ion clusters as a function of cluster size for different nanometer track length for 241Am

[1] Support by CEC under the subcontract, FI4P-CT96-0044 is appreciated.

[2] S.Pszona, IPJ Annual Report 1996, 86
[3] S. Pszona and R. Gajewski, Radiat. Prot. Dosim. 1994, 52, 427.
[4] S.Pszona , The Royal Soc. of Chemistry, Special Publ. 204, 1997, 395 Absolute Efficiency of the Discrete and Channel Electron Multipliers

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4.2 Absolute Efficiency of the Discrete and Channel Electron Multipliers.

by S.Shchemelinin[1], S.Pszona

The absolute efficiency of single ion counting is an important parameter in many experiments. An example of such experiment is simultaneous detection of all ions formed (as ion cluster) along a track of a charged particle. One of the most important prerequisites for such ion cluster measurements is known and possibly high efficiency ion detection. The available literature data on