HEAVY ION BEAM FLUX AND IN-SITU ENERGY MEASUREMENTS AT HIGH LET.

S.V. Mitrofanov1, I.V. Kalagin1, V.A. Skuratov1, Yu.G. Teterov1, V.S. Anashin1.
1. Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia
2. Branch of Joint Stock Company United Rocket and Space Corporation – Institute of Space Device Engineering, Moscow, Russia

The Russian Space Agency with the TL ISDE involvement has been utilizing ion beams from oxygen up to bismuth delivered from cyclotrons of the FLNR JINR accelerator complex for the SEE testing during last seven years. The detailed overview of the diagnostic tool set-up features used for low intensity ion beam parameters evaluation and control during the corresponding experiments is presented. Special attention is paid to measurements of ion flux and energy at high LET levels and evaluation of ion beam uniformity over large (200x200 mm) irradiating areas. The online non-invasive (in-situ) time of flight technique designed for low intensity ion beam energy measurements based on scintillation detectors is considered in details. The system has been successfully commissioned and is used routinely in the SEE testing experiments.

Fine tuning of the beam uniformity: using double side Si strip detector

Ion flux is controlled by using polycarbonate or polyethylene terephthalate track detectors placed in close vicinity of any testing device in all irradiation runs.

Polymer track detector and the DUT

SEM micrograph of polymer track detector

Ar beam distribution over the irradiating area.

The flux results usually available for user in ONE hour after irradiation test.

We realized the online noninvasive time of flight technique in a substance similar to the pickup probes method, with the difference of using here scintillation detectors instead. Detectors with a list of measured energy values for different ion species

TOF energy measurement sensors base is L=1.602 m.

Scheme of the ion beam transport line and experimental set up for SEE testing at the U400M cyclotron:

The beam spatial distribution and flux value are determined and controlled using arrays of five and four active particle detectors: proportional counters and scintillation detectors.

TOF summary

Nondestructive beam monitoring during irradiation – viewing beam around DUT

The ion beam control system visualization.

Croscheck

Use of degrading foils additionally allows us to determine the content of impurities in the ion beam. A clean from impurities ion beam corresponds to one peak on the recorded spectrum. An ion beam with impurities results in split peaks on the spectrum after passing the degrader. Intensity ratio of the peaks occurred after splitting correspond to the proportion of impurities. We could determine energy (LET) of the impurity by the offset of the peak on the spectrum.

Comparison of Ar ion energy measured with the SmartTDC01 and with the PSI DRS4 Evaluation Board

Comparison of measured and calculated (SRIM) Ar ion energy

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