SIRIUS, a polyvalent electron accelerator

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A. Alessi[1,*]

1.LSI, CEA/DRF/IRAMIS, CNRS, Ecole polytechnique, Institut Polytechnique de Paris, 91120 Palaiseau, France

* antonino.alessi@polytechnique.edu

Travelling within a material, electrons can interact in many ways with matter [1,2]. In fact, while soft and hard collisions interactions determine the total ionizing dose (TID), electrons are also able to collide with the nuclei inducing their displacement. Such process is defined as non-ionizing energy loss (NIEL) and it determines the displacement damage dose (DDD). Differing from other particles, through this process, electrons tend to induce isolated defects. As a consequence, electron irradiation is used to study a large number of materials and devices. The main purpose of the presentation is to illustrate the irradiation capability of Sirius and report some examples of investigation performed using this facility. Sirius is an electron accelerator operating with electron beam energies between 150 keV and 2.5 MeV. In these range of energies, the stopping power of the different materials can be constant (at high energies) or features some variation (lower energies), while the efficiency of the displacement damage changes significantly. The accelerator current can be changed in a large range from few nA to about 20 μA allowing a huge variation of the flux. Nowadays, Sirius is equipped with different irradiation cells that are designed for specific irradiation allowing to control the temperature of irradiation or to irradiate samples with large area. In particular, depending on the different cells it is possible to perform irradiations in the range 600-300 K, 300-100 K and 20 K. Thanks to its versatility, Sirius is used by a large community of researchers working in basic physics topics (polymers, defects in glasses, superconductors and etc…) or in more applicative fields (solar cells in space environment, effects of irradiation on materials for radioactive environments and etc…).

[1] F.H. Attix "Introduction to Radiological Physics and Radiation Dosimetry " John Wiley & Sons, Inc . 1986.
[2] J. R. Srour, C. J. Marshall, P. W. Marshall, IEEE Trans. Nucl. Sci. 50, 653–670, 2003.