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THEORETICAL STUDY OF THE OPEN CIRCUIT VOLTAGE DECAY ON ORGANIC PHOTOVOLTAIC (OPV) SOLAR CELLS BASED ON SPACE RADIATION IONIZING DAMAGE.

Abstract

Organic photovoltaic (OPV) solar cells has progressed quite significantly for their potential as an affordable energy technology, with high-throughput roll-to-roll solution processing driving down costs to the point of competitiveness with current technologies also offer significant advantages over classical inorganic semiconductor cells; specifically down costs to the point of competitiveness with current technologies, in turn OPVs are light and can have donor-acceptor structures. Our specific interest, then, concerns the applicability of organic photovoltaics cells for use in space based solar panels.

The present work is an theoretical study of ionizing radiation effects in the organic photovoltaic material P3HT:PCBM for total accumulated doses up to 300 krad(SiO_2).The authors find that the open circuit voltage (V_{oc}) varies with the accumulation of irradiation; however, the other parameters such as relaxation time, short circuit current, and charge carrier density remain to first order constant.

At the interface, the energetic mismatch of the molecular orbitals provides sufficient driving force to split the exciton and create free charge carriers (an electron and a hole), beside this is consistent with observations on preirradiation devices in which all depend directly on the open circuit voltage due to carriers and quasi states in order to linear recombination according to Dose Displacement Damage (D_d) and Non Ionizing Energy Lost (NIEL).

Finally, the authors conclude that the organic photovoltaics will survive in a space environment up to 300 krad(SiO_2), contrary to popular belief that organics would be radiation "soft."