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Ion Irradiation Effects on the Optical Properties of Quantum Dots for Nano-Dosimetric Systems

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Nowadays it is generally accepted that the radiation damage on cells induced by hadron beams is related to the track structure, i.e. to the spatial distribution of stochastic interactions occurring with nanometric volumes.

Luminescent quantum dots (QD) seem to be promising candidates for the realization of portable systems for the evaluation of the nano-dose. Ionization produced in QDs by scattered electrons give rise to quenching or luminescent centers affecting the optical properties of nanocrystals. So, changes of both luminescence features and excited states lifetimes after irradiation can be used for evaluation the damage released by ions in nanometric volumes.
In this work, we studied the optical properties of luminescent QDs irradiated with 2.0 MeV H+ proton beams at different fluences. Semiconductor QDs are dispersed into polysiloxane films at different concentrations on silicon substrates and their luminescence properties are analysed before and after the irradiation. During irradiation the light yield is monitored by means of ion beam induced luminescence (IBIL) measurement. The luminescence bands are measured with a spectrofluorimeter Jasco FP6300 by exciting the samples at different wavelength in order to identify possible distribution of emitting centers or size dependent optical properties. Lifetime measurements are performed with different pulsed lasers, at 355, 405 and 450nm. The lifetime changes after irradiation are correlated with the formation of quenching centers in QDs.
The results are a proof of concept for the realization of a nanodosimeter based on QD luminescence properties.

Country/Organization invited to participate

Italy

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