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Photothermal radiometry study of heavy ion beam induced modification of thermal properties of graphite

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The evolution of thermal properties of samples irradiated with GeV Au and U ions at the UNILAC accelerator at GSI was studied using the photothermal radiometry (PTR) technique. PTR measurements allow a depth resolved measurement of the thermal properties of the irradiated samples. In the present study, this technique is applied to characterize the 50-70 µm thick damaged layer on swift heavy ions irradiated graphite samples. Graphite is used in high power accelerator applications as a materials for beam dumps and production targets. Irradiation-induced degradation of its thermal properties leads to a decreased efficiency of dissipation of the heat deposited by the high intensity ion beam and to premature failure. The thickness of the damaged layer calculated by SRIM was experimentally confirmed by Raman spectroscopy and SEM imaging on the sample' s cross-section. The results show a significant degradation of thermal effusivity down to 20% of the pristine value and a slight decrease of volumetric heat capacity of irradiated graphite at the maximum reached ion fluence of 5e13 i/cm2. The measured thermal properties of the irradiated layers reflect values characteristic to glassy carbon. The offline studies indicate that the non-contact PTR technique can be applied for in situ studies of beam-induced thermal properties degradation.

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