KINETICS OF RADIATION-INDUCED STRUCTURAL ALTERATIONS IN ELECTRON-IRRADIATED POLYMER-BASED COMPOSITES

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In our previous studies measurements of internal friction temperature dependence were used for characterization of thermally activated and radiation-induced structural evolution in different types of polymer-based composites. This paper supplements these measurements with kinetic studies of internal friction (IF) parameters and EPR signals in a glass-cloth epoxy-filled laminate ST-ETF after electron irradiation up to doses of 1-10 MGy. Experiment have shown that the lifetime of free radicals in this composite considerably exceeds the characteristic time of molecular structural rearrangement due to scission and cross-linking after irradiation, as determined from IF measurements. This result is explained by slow proceeding of sterically hindered disproportionation reactions that stabilize the end groups of the macro-chain disrupt during irradiation and finally fix the act of scission. A mathematical model is formulated for description of structural evolution and alterations of IF parameters in polymer-based composites during and after electron irradiation. The description is based on the track model of radiation damage in polymers and phenomenological theory of radiation-induced structural transformations. General description does not give details of radiation-chemical conversion in different structural components of composites but indicates the direction of their structural evolution. In the model considered a composite material was divided into three parts (binder, filler, and a boundary layer). It was supposed that after primary distribution of radiation energy radiation-chemical conversion proceeds independently in each of these regions. It was also suggested that all the radical reactions were of the second order. On the example of glass-cloth laminate ST-ETF it is shown that this model allows to describe alterations in composite structural characteristics during irradiation and in the course of their self-organization after irradiation using experimental data on internal friction in calculations.