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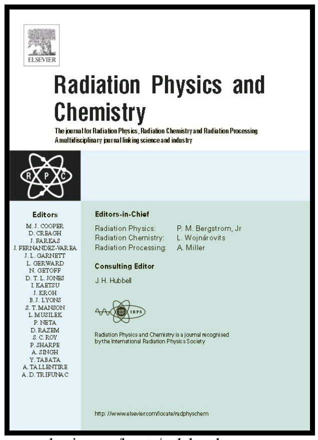

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Boron Filled Siloxane Polymers for Radiation Shielding

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Abstract

The purpose of the present work was to evaluate changes to structure-property relationships of ^{10}B filled siloxane-based polymers when exposed to nuclear reactor radiation. Highly filled polysiloxanes were synthesized with the intent of fabricating materials that could shield high neutron fluences. The newly formulated materials consisted of cross-linked poly-diphenyl-methylsiloxane filled with natural boron and carbon nanofibers. This polymer was chosen because of its good thermal and chemical stabilities, as well as resistance to ionizing radiation thanks to the presence of aromatic groups in the siloxane backbone. Highly isotopically enriched ^{10}B filler was used to provide an efficient neutron radiation shield, and carbon nanofibers were added to improve mechanical strength. This novel polymeric material was exposed in the Annular Core Research Reactor (ACRR) at Sandia National Labs to five different neutron/gamma fluxes consisting of very high neutron fluences within very short time periods. Thermocouples placed on the specimens recorded *in-situ* temperature changes during radiation exposure, which agreed well with those obtained from our MCNP simulations. Changes in the microstructural, thermal, chemical, and mechanical properties were evaluated by SEM, DSC, TGA, FT-IR, NMR, solvent swelling, and uniaxial compressive load measurements. Our results demonstrate that these newly formulated materials are well-suitable to be used in applications that require exposure to different types of ionizing conditions that take place simultaneously.

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