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Gamma radiation resistant behaviour of polysulfone-nanodiamond mixed matrix membrane: The effect of nanoparticle size and loading

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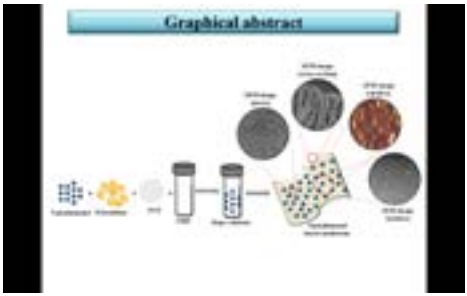
Diamond is a well-known hard and radiation resistant material, and has got several uses in nuclear industry. Owing to the unique properties of the nanodiamond (ND), an attempt has been made to develop gamma radiation resistant polymeric nanocomposite membrane by impregnating different sizes (10, 250 and 500 nm) and loadings (0.1, 0.5, 1 and 2%) of ND into polysulfone (Psf) host matrix. The synthesized membranes were irradiated with 250, 500 and 1000 kGy of gamma radiation with a dose rate of about 1 kGy h−1. The pure water permeability and solute rejection studies (with solutes of polyethylene oxide of molecular weight 100 kDa) of the unirradiated and irradiated membranes were carried out. The morphology, topography and mechanical properties of the membranes were analysed using scanning electron microscopy, atomic force microscopy and universal testing machine (UTM), respectively. The unirradiated composite membranes reinforced with ND of 10 nm was observed to have a defect-free surface, while those with 250 and 500 nm sized NDs are having deteriorated morphology, owing to larger particle size of the filler. The performance (flux and selectivity) and UTM analyses of (un)irradiated membranes up to 1000 kGy showed a similar trend in the radiation stability of nanocomposites, with the 10 nm sized nanodiamond impregnated matrix being the most radiation resistant. Findings confirm that these radiation resistant Psf-ND mixed matrix membranes can have potential applications in nuclear fuel cycle, circumventing the practical limitations encountered in the deployment of polymeric membranes in this domain.



Biography

Amita Bedar is pursuing her PhD from Homi Bhabha National Institute, Bhabha Atomic Reseach Centre, Mumbai (India). She is working on the development of radiation resistant polymeric nanocomposite membrane for the radioactive effluent treatment. She has completed her M. tech. in 2014 from Indian Institute of Technology Gandhinagar, India. During M. Tech., She worked on the synthesis of boron based 2-D nanosheet and publishes her work in Nature Scientific Reports.

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