Shape memory polyurethane nanocomposites with porous architectures for enhanced microwave shielding

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Shape memory polyurethane nanocomposites with porous architectures for enhanced microwave shielding

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Abstract

Thermoplastic Polyurethanes (TPU) are versatile smart materials exhibiting shape memory property and have wide usage in the field of microwave shielding through incorporation of microwave active nanoparticles. The incorporation of high aspect ratio particles into the shape memory polymer matrix may however lead to increase in stiffness and thereby loss of shape memory property. To successfully incorporate high aspect ratio nanoparticles in the polymer matrix, porous polyurethane membranes were prepared by phase inversion technique using polyethylene glycol (PEG) as pore forming agent. The pore sizes were tuned of the order of 1-3 µm in size by varying the PEG concentration in the dope solution to facilitate the vacuum filtration of an aqueous nanoparticles solution through the porous structure. This technique helped to preserve the shape memory property of PU which would otherwise be disturbed if nanoparticles were incorporated into the polymer matrix. From the results obtained it was clear that this strategy of coating nanoparticles onto the porous membranes helped in achieving good shielding effectiveness at relatively lower membrane thickness without compromising much on the shape memory property of the membranes which otherwise is impeded at higher filler content. When stacked to form a sandwich structure of about 400 µm thickness, the membranes showed a high shielding effectiveness of -32 dB manifesting in 99.9 % attenuation of electromagnetic radiations.