

The silicon rubber review

[Science](#), [Chemistry](#)



The silicon rubber used was methyl end blocked poly-dimethylsiloxane provided by Jyothi rubbers, Thrissur, India. n-hexane purchased from Merk Private Limited, Mumbai, India was used as the solvent for composite preparation. The curing agent used for the vulcanization of rubber was dicumyl peroxide (DCP) purchased from TCI. High purity powders of carbon black (CB) (99.9%) was purchased from Sigma Aldrich. The chemicals such as graphite flakes, KMnO_4 , hydrogen peroxide (30% EMPARTA®), H_2SO_4 , hydrazine hydrate were purchased from Merk Private Limited, Mumbai, India.

Preparation of the composite

The method followed for the preparation of hybrids were given in the supporting information. Solution mixing was followed to get homogeneous composite. Dispersion of high surface area carbon clusters directly into highly viscous polymer dispersion is very difficult. However by following solution mixing process, the matrix viscosity can be effectively minimized by the solvent and also increase the filler-solvent interaction thereby distribute the filler particles prior to mixing. This can enhance the dispersibility as well as high filler uptake in the polymer matrix. First, silicone rubber, before crosslinking, was dissolved in the solvent to obtain homogeneous solution. Meanwhile fillers were dispersed in the solvent and ultra-sonicated for 30 minutes. Then mixed the above solutions and ultra-sonicated for 1h to obtain homogeneous suspension. For the preparation of reinforced polymer, rGO and CB were dispersed into the solvent separately and ultra-sonicated for 30 min and then mixed the solutions and again sonicated for extra one hour, before mixing with the viscous polymer solution. Dried the mixture overnight using an oven at 60°C . For vulcanization of rubber, DCP was added and the

composites obtained were then hot pressed at 200 °C for 20 min under a pressure of 2 MPa with appropriate dies.

Material characterization

The phase identification of the samples was performed using an X-ray diffractometer (Bruker D8 Advance Diffractometer) with CuK α radiation employing a proprietary high-speed detector and a monochromator at the diffracted beam side. Microstructure analysis of the samples was done using a scanning electron microscope (Carl Zeiss EVO 18 secondary electron Microscope). For graphene and graphene incorporated composites, the microstructural analysis was done with FESEM (FEI Nova Nano SEM 450). FT-IR spectra of the samples were recorded in the attenuated total reflectance (ATR) mode with a resolution of 4 cm⁻¹ from 4000 to 400 cm⁻¹ region using PerkinElmer FT-IR/ FIR Frontier spectrometer. AC conductivity of the composites were measured in the frequency range of 100 Hz – 1 MHz at room temperature using LCR meter (HIOKI 3532-50 LCR HI TESTER, JAPAN). Disc shaped samples having diameter 12 mm and thickness 1.5 mm was used for the dielectric measurement. Room temperature curable silver paste (Siltech Corporation, Bangalore, India) was used as electrode. The EMI shielding effectiveness (SE) of the samples in the microwave region (X and Ku band, 8.2-18 GHz) was measured using a vector network analyzer (E5071C) by fixing the suitably machined samples in the cavity of a waveguide. Separate waveguides were used for each band. The rectangular samples of dimensions 22.7 mm × 10.2 mm × 1.5 mm and 15.8 mm × 7.9 mm × 1.5 mm were used for X and Ku band measurements respectively. The complex permittivity of the samples at microwave frequencies were also

calculated from the measured scattering parameters using Agilent software 85071E.