Development of Functionalized Core–shell Nanohybrid/Synthetic Rubber Nanocomposites with Enhanced Performance

Jingbiao Liu[a], Zhenqing Wang*[a], Shuzhou Li[b], Jianxin Teng[a], Benzhi Min[a]

[a]College of Aerospace and Civil Engineering, Harbin Engineering University, Harbin, China
[b]School of Materials Science and Engineering, Nanyang Technological University, Singapore 639798, Singapore
*Corresponding author: wangzhenqing@hrbeu.edu.cn, lisz@ntu.edu.sg

Supporting Information

The crosslinking density was determined from equilibrium swelling measurements. Firstly, the sample of a certain quality was weighed and put into a conical bottle containing toluene solvent. The sample was immersed in the solvent, and the bottle stopper was tightly capped. Then the conical bottle was placed in a constant temperature water bath at 30 ℃ until the sample reached swelling equilibrium. After reaching the swelling equilibrium, the samples were immediately weighed and then dried in a vacuum oven at 50 ℃ for 48 h to remove the solvent, and then reweighed. The elastically active network chain density, γ, which denoting the whole crosslinking density, was calculated by the Flory-Rehner equation. The Flory-Rehner equation is as follows:

$$\gamma = -\frac{\ln(1-V_r)+V_r+\chi V_r^2}{V_s(V_r^{1/3}-V_r/2)} \qquad (1)$$

where γ is the number of active network chain segments per unit of volume (crosslinking density), V_r is the volume fraction of rubber in the swollen network, V_s is the molar volume of the solvent, and χ is the interaction parameter. V_s was calculated by the following equation:

$$V_r = \frac{w_2/\rho_2}{w_2/\rho_2+(w_1-w_2)/\rho_1} \qquad (2)$$

where w_1 is the mass of the sample after swelling equilibrium, w_2 is the mass of dried sample after swelling equilibrium, and ρ_1 and ρ_2 refer to the density of the test specimen and solvent, respectively.

2. Detail procedures of bound rubber content test

Filling rubber compounds (1 g) was accurately weighed, cut into pieces, wrapped in filter net, put into 200 mL toluene solvent and soaked in 30 ℃ continuously for 1 week (change the

solvent once every 2 days), then removed wrap and let it stand in the air for 4 h, and finally dried it to a constant mass in vacuum.