Study on Nanocomposite Thermoplastic Elastomer Gels

Mature A. Pachiaross, Mardar Balamianman and Jia Kik Kim

Department of Polymer Science and Engineering
Gyeongsang National University, Jinju, 660-701 Korea

**Introduction**

Block copolymers are a representative class of soft polymeric materials, which are produced by covalently linking two or more copolymeric linear segments (blocks) of chemically dissimilar species [1-2]. A common feature of block copolymers is that they can form a variety of self-assembled nanostructured systems, which depends primarily on molecular composition, thermodynamic incompatibility of blocks and monomer of asymmetry. Block copolymers have a number of unique properties resulting from their morphological features. Because of these properties, block copolymers have been used in a wide range of applications, for example, thermoplastic elastomers for impact modification, compatibilization and pressure-driven adhesion. One of the most highly investigated copolymer families employed is the commercially available poly(styrene-ethylene-co-butylene-co-styrene) (SEBS) triblock copolymer, which is employed in a diverse range of contemporary technologies. The ability of the SEBS to establish microstructural changes as physical stress is applied to the copolymer solution behavior as physical stress is applied is obvious, and these changes can be attributed to the improved mechanical properties of these systems in extended oils and solvents. The purpose of the study is to generate nanocomposite thermoplastic elastomer gels consisting of both organic and nanofiller interpenetrating networks with enhanced properties. The linear viscoelastic properties of nanocomposite TPE gels were taken for study and measured as a function of temperature and stress relaxation time. Sol-gel transition and mechanical properties of nanocomposite TPE gels were studied. X-ray diffraction was also performed.

**Experimental**

Poly(styrene-ethylene-co-butylene-co-styrene), with styrene (rubber ratio of 29/71, number molecular weight of 9,000 and polydispersity of 1.03) and white oil with molecular weight of 500 were used in this study. Different types of nanofiller materials such as graphite were used. The nanocomposite TPE gels were prepared similar to the procedure described [11]. The ratio of white oil to the SEBS was 0.67 and 0.4 with different amounts of nanofiller materials. The dynamic rheological measurements were conducted on a Rheometric Mechanical Spectrometer (RMS) StressHier HR model, Rheolab Instruments, USA operated with 25 mm parallel plate geometry and a 1.5 or 2.5 mm gap heights. The tensile strength and elongation at break for ratios of 0.67 were performed on a Lloyd LR1.10K tensile testing machine (Farhan, Hampshire, UK), while TPE gels with ratio of 0.67 in a Tenacostat 2000 (South Korea). The crosshead speed was 50 mm/min with a load cell of 100 N and a gauge length of 20 mm. The X-ray diffraction data was taken using an X-ray diffractometer with CuKα radiation, with a scan speed of 0.05°/s and a scan range of 2θ from 5° to 45°.

**Results and Discussion**

One of the most highly investigated copolymer families employed in this area consists of poly(styrene-ethylene-co-butylene-co-styrene) (SEBS) triblock copolymer, which are employed in a diverse range of contemporary technologies. An illustration transmission electron microscope (TEM) image of a SEBS triblock copolymer in 60 wt% (BS-solvent) alkyl alcohol oil [13] and verifies the micellar morphology anticipated from complementary small-angle scattering results. A shortening of TPE gels on the basis of the SEBS triblock copolymer is an inherently low modulus and a relatively low minimum operating temperature identified as the temperature at which the gel network no longer supports an applied load and the solution flows as the modulus decreases abruptly. Addition of graphite in TPE gels in both ratios of all SEBS shows that both (G雅思G雅思) increase slightly with increasing nanofiller content. In all gels, it shows G雅思G雅思 as a function of temperature. It seems that addition of nanofiller has no significant effect on the sol-gel transition. In X-ray diffraction results that d-value of graphitic in TPE gels shifted. Whereas the tensile strength increases as well as the elongation at break.

**Conclusion**

The addition of different types of nanofiller to a micellar SEBS oil gels at different amounts of oil serves to reinforce the gel as evidenced by an increase in G雅思. This increase reflects the formation of a secondary network that reinforces the primary network formed by the gel. It was also found that mechanical properties increase at lower nanofiller concentration but tend to decrease when the paraffin/SEBS ratio is lower. The sol-gel transition is the same for all nanocomposite TPE gels. At ambient temperature, the nanocomposite TPE gels are more elastic characteristics, t less (G雅思) is much lower storage modulus (G雅思) indicating physical network being present.

**References**