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Optimized Silica Fraction in Silicone Rubber

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Abstract: The mechanical properties and the hierarchical filler structures were characterized on a series silica-filled silicone rubber with a filler fraction (Φ_{Si}) varied from 0.05 phr to 80 phr (parts per hundred rubber). Uniaxial elongation measurement suggests that there is a percolation threshold between 10~30 phr. Moreover, an optimum Φ_{Si} range from 40 phr to 50 phr is found, in which the best mechanical performances of reinforcement are shown. The microscopic structures were crosschecked by small-angle neutron scattering (SANS) and scanning electron microscopy (SEM). The effects of the Φ_{Si} and the fabrication process on the morphology of samples are unveiled. The correlation length among aggregates extracted from SANS data a monotonically decrease from 237.0 nm to 136.5 nm with increasing the Φ_{Si} from 30 phr to 80 phr. The average radius of gyration of aggregates $\langle R_{g,agg} \rangle$ fitted with the Beaucage model monotonically decrease from 49.2 nm to 37.5 nm with increasing Φ_{Si} from 10 phr to 80

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