FILLER NETWORKING AND REINFORCEMENT OF CARBON BLACK FILLED STYRENE BUTADIENE RUBBER

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The reinforcement of polymers is accompanied by the formation of the region of interfacial interaction between the polymer matrix and filler, which leads to a general change in thermodynamic properties of the system. Based on the time-temperature-superposition principle dynamic-mechanical measurements at different temperatures can be used to cover a large frequency range by creating dynamic-mechanical master curves. In the present approach the combined effect of filler networking and reduced chain mobility close to the filler interface is analyzed based on investigations of the relaxation dynamics of solution styrene butadiene rubber filled with different loadings and types of nano-structured carbon black. Dynamic-mechanical and dielectric spectra are studied in a wide frequency and temperature range. It is demonstrated that the time-temperature-superposition-principle is not fulfilled for filled elastomers and the introduction of vertical shift factors is necessary to obtain viscoelastic master curves. The changes in the dynamic-mechanical properties by the incorporation of fillers are shown to be related to the superimposed dynamics of the filler network governed by the viscoelastic response of glassy-like polymer bridges between adjacent filler particles. Additionally, dielectric spectra show that the filler-filler distance is decreasing with increasing filler loading and filler activity (Figure 1). The reduced chain mobility close to the filler interface becomes apparent by a broadening of the glass transition on the low frequency side visible in relaxation time spectra.

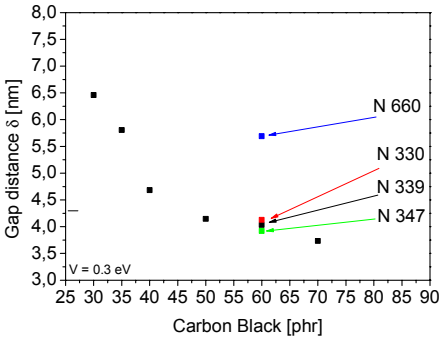
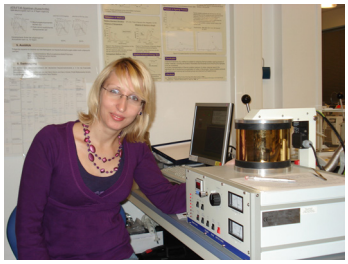


Figure 1: Calculated gap width δ for SBR 2525-0 filled with various loadings of N 339 and other carbon black grades



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