

# **RHEOLOGICAL BEHAVIOUR OF POLYCARBONATE – MULTI-WALLED CARBON NANOTUBE NANOCOMPOSITES**

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This work presents preliminary findings from a project whose aim is to characterise the role of the matrix on solid-state and melt-state properties of multi-walled carbon nanotube (MWCNT) nanocomposites. Four grades of polycarbonate with weight-averaged molar mass ranging from 33.6 – 50.5 kg mol<sup>-1</sup> were utilised as matrix materials. In this preliminary study, 3% MWCNTs by weight (Nanocyl NC7000) were extrusion blended with the matrix material with  $M_w = 33.6$  kg mol<sup>-1</sup> only. Rheological experiments were performed on all unfilled matrices and on the filled nanocomposite using a Bohlin Instruments C-VOR rheometer. Amplitude sweeps revealed that the linear viscoelastic limit is considerably reduced by the presence of nanotubes. Oscillatory experiments at fixed frequency during annealing have shown a gradual build-up of structure over a period of approximately 15 minutes. Oscillations at larger amplitudes in the nanocomposite could be responsible for the destruction of this structure, and hence in the reduced linear viscoelastic limit relative to the unfilled materials.

Linear viscoelastic frequency sweeps were performed at a range of temperatures from 160°C to 260°C (unfilled) and 160°C to 300°C (filled). The experimental data was then time-temperature shifted using an in-house optimiser. Whereas the unfilled resins exhibit a drop in  $G'$  (associated with flow) of almost 5 orders of magnitude across the temperature range, the drop in  $G'$  in the filled resin was only 1.5 orders of magnitude. Irrespective of this, shift factors determined independently on each material appear to be independent of both the molar mass of the resin and of the presence of nanotubes. This is a significant finding, since it implies that a single set of time-temperature superposition parameters can be used for modelling the linear rheology of both unfilled and filled materials. Future work will focus on the role of nanotubes and of the matrix on viscoelastic material properties below the glass transition, and on the electrical conductivity of the nanocomposites.