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Melt Spinning of Composites of Polycarbonate with Multiwalled Carbon Nanotubes

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Composites of polycarbonate (PC) with multiwalled carbon nanotubes (MWNT) were prepared by diluting a PC masterbatch consisting of 15 wt% MWNT by melt mixing in an extruder. The conductive PC composite containing 2 wt% MWNT and the pure PC were melt spun using a piston type spinning device. Different mass throughputs and spinning speeds up to 800 m/min were used. The alignment of the nanotubes along the fiber axis was investigated by TEM investigations and polarized Raman spectroscopy regarding the D and G bands of the MWNT. The nanotubes align in their length axis along the fiber axis increasingly with increasing take-up velocity, however, the curved shape of the nanotubes still exist in the melt spun fibers. At higher take-up velocity, the MWNT started to align by reducing their curvature. Polarized Raman spectroscopy indicated that the D/D and G/G ratios parallel/perpendicular to the fiber axis increase for both bands in a similar manner with the take-up velocity. Interestingly, with increasing alignment electrical conductivity of the fibers is lost. Mechanical properties of the composites were tested and compared using the stress-strain behaviour of the filaments. At low spinning speeds, elongation at break and tensile strength of the composites with 2 wt% MWNT are lower than those of the pure PC. Surprisingly, the decrease of elongation at break with increasing spinning speed is lower in case of the composites as compared to pure PC. Therefore, the true stress at break for the melt spun composite fibres increases with spinning speed. At the high take-up velocity of 800 m/min the elongation at break is higher and true stress at break for the composite fibers is comparable to the pure PC fibers.