Functional fibres prepared by melt spinning of conducting polymer composites

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Melt spinning is the preferred technology for high volume production of fibres. The process induces high anisotropy and sometimes dramatic changes are seen in the physical properties of the material, both wanted and unwanted. Melt spun fibres prepared from conducting polymer composites (CPC) offer great possibilities in tailoring the properties of fibres for production of yarns with a high degree of functionality. Conducting fibers prepared from CPC however are limited to antistatic and ESD purposes due to limitations in processing such as reduction of ultimate draw down ratio with increasing filler content and loss of conductivity during drawing. New fillers such as carbon nanotubes (CNT) have been suggested as promising solutions. In the presented work we mix polyethylene (PE) or polypropylene (PP) with relatively high filler concentrations from two CNT-masterbatches, where one was prepared by in-situ polymerisation and one by melt compounding. A highly conductive grade of CB was also tested as a reference. Electrical percolation curves between 2 and 14 wt% were made as well as rheological measurements for the blends. The influence of drawing on conductivity was studied and the ultimate draw down ratio at 4 wt% filler content for different die geometries and processing rates was determined. A relationship was found between shear viscosity and conductivity of the materials. The ultimate draw down ratio decreased significantly with increasing filler content above the percolation threshold of each mixture, materials with high conductivity generally had low ultimate draw down ratio. Capillary geometry and extrusion rate showed significant influence on the ultimate draw down ratio as expected. Conductivity was lost gradually with increasing draw ratio when CB was used. For CNTs however, no relationship could be established since conductivity was reduced below the level of detection for all draw ratios and concentrations studied. Using bicomponent technology on a labscale equipment, a fiber with both high conductivity and high strength was produced.