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*Correlating Structural Control For Property Enhancement In Nano-Composite Fibers*

Understanding the capabilities of polymeric materials to form interfacial structures around carbon nanotube and other nano-carbon materials is instrumental toward controlling composite structure-property correlations. This work outlines developments regarding new processing routes for dispersing nano-carbons in dilute polymer solutions. This dispersion process involved steps of sonication, shearing, and crystallization. The specific combination of these processes results in the formation of polymer interfacial growth (i.e., interphase structures) on the nano-carbon surfaces. The interphase formed consists of either extended-chain or folded-chain polymer crystals depending on the processing route used. This processing approach for the dispersion of nano-carbons and subsequent formation of the polymer interphase is further implemented into fiber processing procedures. Polymer materials used in these composite fiber studies include polyacrylonitrile (PAN), polyvinyl alcohol (PVA), polyethylene (PE), as well as collagen proteins. The nano-carbons include carbon nanotubes (CNT) and carbon nano-chips (CNC) (i.e., platelet morphology). In addition, boron nitride platelets were also studied. Several process modifications were made to the fiber spinning procedure to ensure the formation of interphase structures within all the composite fibers formed. It was found that polymer crystal growth and entropy changes in the system (e.g., biological materials) should be well-controlled to form specific interphase morphology. For this reason, such studies were also performed for all the polymeric materials used in the presence of the nano-materials. In general these composite fiber studies showed that the inclusion of interphase structures in the composite fiber led to dramatic increases in the mechanical properties. Beyond mechanical enhancement, the composite fiber morphology was also examined to understand the fundamental links between the processing route use and the resultant structure-property relationship. A general overview regarding the results of these studies will be outlined and discussed in this talk.