Oral Presentation – Composite Materials

Nano Materials for Optimization of Polymer Systems

G. Dillon

1. Penn State Erie, The Behrend College, Erie PA, USA

Summary

The required performance spectra for polymer systems continue to expand, placing ever more challenging demands on materials development initiatives. Advanced thermoplastics meet many such needs as polymer chemistries and associated architectures become increasingly more varied and sophisticated. In many cases, however, single component materials cannot provide the property spectrum required and material additives are needed to confer a wide variety of enhanced properties. Erosion and corrosion resistance, thermal and electrical conductivity and surface characteristics are among the many properties that can be engineered by incorporation of additives into a material class that offers the advantages of light weight, low cost and ease of processing. This paper describes a series of ongoing initiatives at Penn State Erie, in which nano materials are being used to meet specific material performance requirements from a range of perspectives including cost effective process development. Results are provided and lessons learned are summarized.

Motivation and results

This presentation explores the use of nano materials in polymer based composite systems as applied in a number of ongoing programs at Penn State Erie, The Behrend College. The work considers the entire development process for potentially commercially viable nano modified polymers, including compounding, sample design, flow modeling, process development, microstructural characterization, mold design, component prototyping and production evolution. The presentation addresses the use of advanced thermal characterization techniques to determine critical resultant physical properties and explores the critical links between, structure, process and properties for advanced material systems. Additives including nano clays, carbon nano tubes and nano diamond are considered in the context of applications that require property modifications in the realms of thermal conductivity, electrical conductivity, erosion and wear resistance as well as processibility. The talk also highlights the unique capability for commercial polymer process development resident at Penn State, Erie where the country's largest university based processing lab is supported by world class characterization assets in Erie and at the Materials Research Institute. Finally, the presentation also touches on new initiatives in additive manufacturing, in which fibers and particulates are being used to provide material properties more representative of requirements in commercial applications. This work aligns with current research trends through which the unique geometric process flexibility afforded by additive manufacturing can be combined with commensurate freedom in material design to evolve specialized products and associated manufacturing technologies. It is worth noting that all initiatives described in the presentation are being pursued in collaboration with commercial ventures. Therefore results are presented in generic form with emphasis on the broader implications for materials and process development initiatives of this kind.

Word count: 419

Corresponding author

Dr. Gregory Dillon,
Penn State Erie – The Behrend College
5101 Jordan Road
Erie, PA 16563
USA
+814 898 7169 phone
+814 898 6125 fax
dillon@psu.edu