

Processing of Polymers and Composites

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Keywords : Polymers, Composites, Rheology, Numerical Analysis

1. Introduction

Basic rheological principles and numerical analysis methods are important for economical and efficient manufacturing of polymers and polymer composites. The polymer and composite materials processing methods are employed to produce various parts used in many areas like automotive, electronics, and aerospace industries. Some important issues which should be considered for production of polymeric parts, e.g., dimensional accuracy of the final parts, residual stress distribution in the molded products, fiber orientation in the composites, rheological behavior in microfluidic channels, and optical properties of nanostructures are studied.

2. Applications

Macroscopic and nano-microscopic applications of the polymer and composite materials processing are explored to provide fundamental ideas and understand major mechanisms. Macroscopic applications include injection molding of fiber composites, overmolding of polymeric parts, prediction of residual stresses and creep behavior of large structures, and numerical simulation of VARTM (vacuum assisted resin transfer molding). Nano-microscopic applications include injection molding of nano-micro patterns for microfluidic devices, sound absorption of hybrid syntactic foam micro-structure, nano-transfer process of photonic crystals for OLED devices, particle focusing in micro channels of the microfluidic devices, tunable optofluidic birefringent lens, processing meta-materials for optical applications, processing of hydrophobic nano-patterns, energy harvesting based on magnetorheology, and design of a meta-material cloak for zero drag coefficient. Some important results on the above topics are illustrated.

3. Conclusion

Polymers and polymeric composites have tremendous potential for industrial applications. For successful applications, both traditional and novel processing methods for polymers and composites should be investigated.

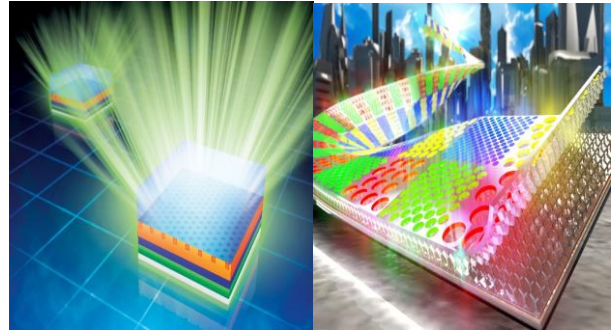


Fig. 1. Vacuum nano-hole embedded light emitting diodes and nano-structured plasmonic meta-surfaces emitting various colors..

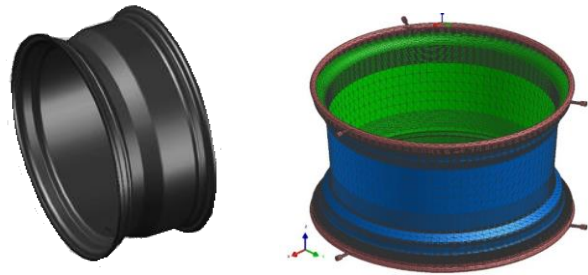


Fig. 2. Numerical analysis for VARTM of carbon composite wheel.

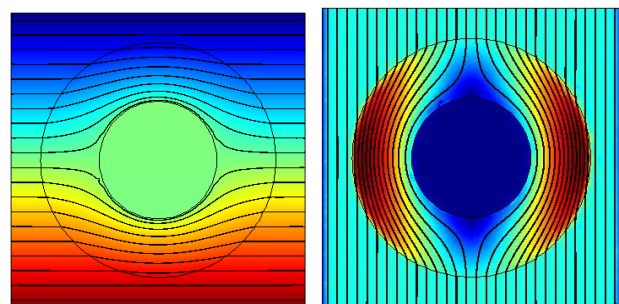


Fig. 3. Pressure and velocity fields around the rheological meta-material cloak.