Correlation of mechanical and electrical properties with processing variables in MWCNT reinforced thermoplastic nanocomposites

The influence of the processing variables and nanotube content on the mechanical and electrical properties of polyamide 6.6-based nanocomposites reinforced with multi-walled carbon nanotubes is investigated. Results show that variation in the processing variables such as compounding method, injection melt temperature, injection speed, mold temperature, and holding pressure varies the properties significantly. In fact, composites containing similar contents of the nanofillers show variations in mechanical properties up to 30.0% and in the electrical properties up to three orders of magnitude. Different processing parameters required for achieving optimal mechanical and electrical performances are also found. Correlation between processing parameters and microstructure within the nanocomposites is studied. Results show that variation of the processing parameters defines the existence or absence of a nanotube network in the nanocomposite structure. Experimental and micromechanical modeling results show that less control over the nanocomposite morphology and nanotube alignment is achievable in higher nanofiller contents. The underlying mechanisms responsible for the modulation in the properties are also discussed using scanning and transmission electron microscopy, rheological and crystallization investigations. The research provides a recipe to manufacture the tailored nanocomposite with the specified properties for various industrial applications.

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