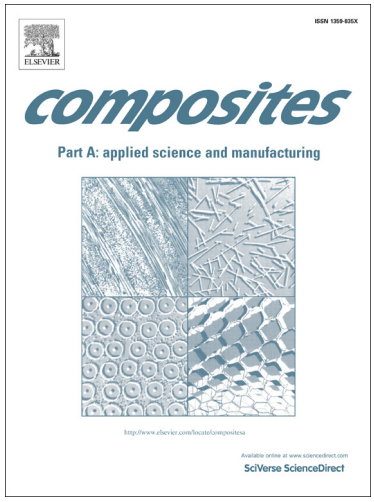

Design of Natural Fiber Composites Utilizing Interfacial Crystallinity and Affinity

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Design of Natural Fiber Composites Utilizing Interfacial Crystallinity and Affinity

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Abstract

Butanediol initiated poly(ε-caprolactone) (PCL) has recently been reported as a toughening agent for cationically curing cycloaliphatic epoxides providing plasticized thermosets with excellent properties [1]. In this contribution that promising toughening approach was applied for the first time for the development of novel natural fiber composites (NFC). NFCs based on conventional brittle thermosetting polymers often suffer from poor interfacial adhesion and stress cracking. Composites made up of the novel plasticized thermosets and woven flax fiber preserved the elastomer-like properties and increased tensile strength and elongation at break up to 60 MPa and 5 %, respectively. Furthermore, PCL was shown not only to toughen the epoxide but also to modulate the affinity of the matrix to the fiber. In conclusion, improved interfacial adhesion and the resulting excellent mechanical properties of cationically curable NFCs were achieved by both interfacial crystallization and affinity.

Keywords

A. Thermosetting resin; Crystallization; B. Fiber/matrix bond; B. Interface/interphase

1. Introduction

Fiber reinforced plastics (FRP) are materials commonly applied in light weight constructions effecting an economy regarding such factors as raw materials, operating costs, fuel consumption. Aside from synthetic fibers like carbon, glass and aramid, natural fibers have become an increasingly attractive reinforcement material. They feature a number of ecological and economic advantages such as lower production costs, reduced energy usage, high specific stiffness and strength, recyclebility, renewability, and an absence of health hazards. However, the poor compatibility of the hydrophilic fiber with the hydrophobic polymer matrix restricts the mechanical performance of natural fiber reinforced composites (NFC). To overcome the problem of poor interfacial adhesion, natural fibers are generally modified by physical methods [2,3,4] such as corona and plasma treatment, and chemical modifications [2,5,6,7,8] such as silane, alkaline and enzyme treatment as well as acetylation and maleated coupling. Enhancement of the fiber/matrix interaction through interfacial crystallization is a promising approach which was applied on semicrystalline thermoplastic polymers such as polylactide (PLA) [9,10], poly(ε-caprolactone (PCL) [11] and isotactic polypropylene (PP) [12] by reinforcing them with fibers exhibiting nucleating ability.