STRUCTURE AND PROPERTIES OF PLA COMPOSITES

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ABSTRACT

Polylactide is biodegradable thermoplastic polymer, polyester derived from renewable sources of energy. It is considered as a sustainable alternative to petrochemical products, since the lactides can be produced by microbial fermentation. Of special interest are investigations of nanofillers addition because of its high specific surface area achieve great contact with the matrix and thereby in small amount they can change the properties of the matrix.

In this study, mechanical and thermal properties of polylactide have been studied with the addition of 5% mass of fillers. The fillers which were used are calcium carbonate fillers PCC 400, U1 and RM5, microfiller perlite and Al $(OH)_3$, and silica nanofillers A130 and A380. A multiwall carbon nanotube (MWCNTs) was also used. Thermal properties were determined by differential scanning calorimetry (DSC) and thermal stability by thermogravimetric analysis (TGA). Mechanical properties of PLA polymer matrix and composite systems were determined by uniaxial tensile test at the universal machine for mechanical testing. The structure and chemical composition of fillers, particle size distribution and morphology of fillers were also determined.

Results showed that the addition of fillers does not influence the glass transition temperature. The changes are observed in cold crystallization where all fillers slow down crystallization, except MWCNT that significantly accelerate crystallization. Additions of fillers change recrystallization, which is caused by melting and immediately after that by crystallization of less perfect crystals formed during cold crystallization. Melting temperature indicate that presence of fillers have no influence on perfection of PLA crystals formed during heating. Fillers can also change the appearance of materials. All fillers, except silica fillers A130 and A380, disturb the transparency of transparent PLA matrix. The investigation of thermal stability showed that all fillers, except MWCNTs, impair or does not change significantly the thermal stability of PLA matrix. MWCNTs improved thermal properties. Addition of fillers changes the mechanical properties. Generally, most of the filler reduces the tensile strength and elongation at break and increases Young's modulus.