Abstract

Bearing in mind environmental concerns and global trends in ecology, biodegradable polyesters have gained enormous attention as alternative to non-biodegradable, commercial polymers used mainly in packaging industry contributing to the worldwide environment pollution. However, substitution of conventional polymers with biodegradable polyesters is limited due to their inferior mechanical and barrier properties, which can be improved by the introduction of relatively small content of non-toxic nanofillers. Nevertheless, environmental pollution is not only affected by material itself, but also manufacturing and processing sector in terms of energy sustainability. In case of the latter, low energetic processes are nowadays preferential. Thus, using microwave irradiation as the more efficient energy source, which can lead to shortening of process time, has become currently investigated subject.

In this thesis, microwave-assisted *in-situ* synthesis of biodegradable nanocomposites based on polycaprolactone and non-toxic clay nanoparticles (layered double hydroxides) was studied and described in detail in four subsections (4.1-4.4).

The first subsection (4.1) describes one-pot synthesis of Mg^{2+}/Al^{3+} layered double hydroxides functionalized with highly microwave-absorbing ionic liquids. In order to improve homogeneity of the nanoparticles synthesized in the subsection 4.1, Ca^{2+}/Al^{3+} layered double hydroxides were prepared and further functionalized with one ionic liquid. These nanoparticles were subsequently used for the *in-situ* microwave-assisted ring opening polymerization of ε-caprolactone (subsection 4.2). This section describes also mechanism, kinetics and thermodynamics of the studied polymerization. Subsection 4.3 compares *in-situ* polymerization and melt-blending as two preparation methods of polycaprolactone nanocomposites and describes the effect of the ionic liquid-layered double hydroxides on their mechanical, thermal, and barrier properties. The influence of the alternative (antibacterial) ionic liquid-functionalized Zn^{2+}/Al^{3+} layered double hydroxides on the application-related properties of nanocomposites (barrier, bactericidal) was further described in the subsection 4.4, where the biodegradability of such prepared nanocomposites was also evaluated.

It has been demonstrated that microwave-assisted *in-situ* ring opening polymerization of ε-caprolactone in the presence of ionic liquid-layered double hydroxides is a sustainable route for biodegradable polycaprolactone nanocomposites, which have a high application potential for e.g. active bio-packaging.