Composite materials based on polybenzoxazine resins

Author: Corina ANDRONESCU
Phd superviser: prof. Horia IOVU

In this work, new results concerning benzoxazines/polybenzoxazines were presented. The curing mechanism of aromatic diamine benzoxazine was established using a new synthesized benzoxazine compound named bis [6-benziloxy-3,4-dihydro-2H-1,3-benzoxazinyl] diphenyl methane. The influence of the synthesis time on the polybenzoxazine precursor composition was investigated in detail using NMR spectroscopy and GPC. Two curing protocols were used for the benzoxazine polymerization. It was found that curing at high temperatures (250 °C), which is often used in the literature, leads to a less stable network as compared with that obtained at lower temperatures (190 °C). Nanocomposite materials using this monomer and two types of commercial MMT were synthesized. No improvement in terms of thermal stability or glass transition temperature was achieved due to the poor interaction and low dispersion of the MMT within the polymer matrix.

A new strategy to obtain polybenzoxazine/MMT nanocomposites was proposed to overcome the poor compatibility between MMT and the polybenzoxazine matrix. The synthesis of a hybrid benzoxazine monomer by in-situ synthesis of benzoxazine inside MMT layers was investigated by using modified MMT with a protonated diamine as an amine component in the reaction with phenol and formaldehyde. The formation of the hybrid benzoxazine monomer inside MMT layers was proved by XPS, ^{1}H-NMR and XRD.

Using 3,3'-(hexane-1,6-diyl)bis-(3,4-dihydro-2*H*-1,3-benzoxazine) as monomer, Raman spectroscopy was involved for the first time to monitor the curing reaction, the obtained results showing that this technique may be applied as a good alternative to other methods (like DSC, FT-IR) to investigate the curing of benzoxazine monomers.

A new class of polybenzoxazine nanocomposites was designed using layered double hydroxides (LDH). The characterization of the composite materials was done using FT-IR, DSC, XRD, TEM, SEM, TGA and DMA.

possibility to use polybenzoxazines as alternative to other polymers as immobilization matrix for enzymes in biosensors applications was for the first time envisaged. Polybenzoxazines were hence proposed as a new family of polymers enabling the design of stable enzyme electrodes for sensor or biofuel cell applications offering additionally the advantage of controlled immobilization by electrochemically induced polymerization.