NANOCOMPOSITES OF ENCAPSULATED AND EXFOLIATED INORGANIC LAMELLAR FILLERS INTO ELECTROSPUN NANOFIBERS

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The present study reports, for the first time, the successful fabrication of layered double hydroxide (LDH) reinforced polycaprolactone (PCL) nanofibers by electrospinning. Either the LDH in carbonate form or an LDH organically modified with 12-hydroxydodecanoic acid (LDH-HA) were incorporated into PCL and electrospun. The LDH-HA was prepared by ionic exchange reaction from pristine LDH and encapsulated into PCL from acetone solutions at 15 wt%.

The structure of LDHs originates from the packing of layers built up in a manner similar to that found in brucite, the naturally occurring $Mg(OH)_2$. In this mineral the Mg atoms are octahedrally co-ordinated by six oxygen atoms belonging to six OH groups; each OH group is, in turn, shared by three octahedral cations and points the hydrogen atom to the interlayer space. When some of Mg(II) cations are isomorphously replaced by Al(III) cations, the substitution creates positive charges balanced by the presence of counter-anions located into the interlamellar region. The possibility to replace these anions by simple ion-exchange procedures makes LDHs a unique class of layered solids to be used as host of active molecules.

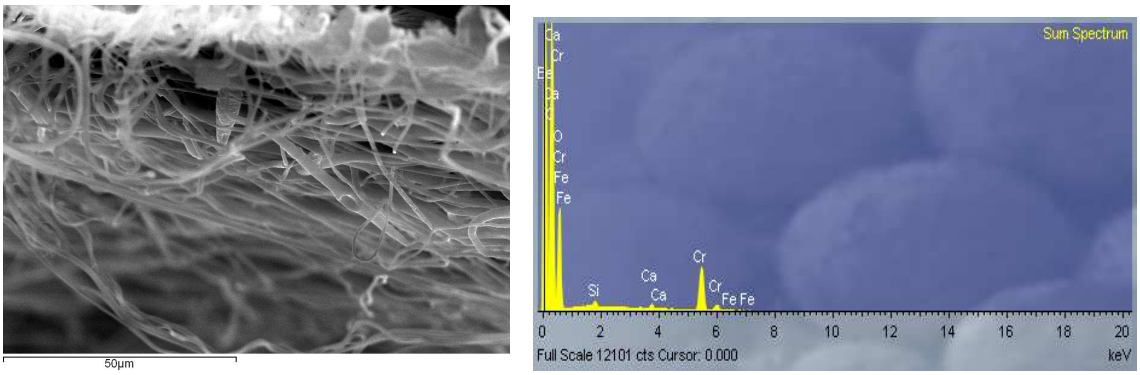

Figure 1: FESEM equipped with an energy dispersive X-ray spectroscopy (EDX) micrographs of electrospun fibers of the surface of PCL + 5% LDH-HA.

The morphological analysis showed for pure PCL fibers with an average diameter of 600 ± 50 nm, and this dimension was maintained in the fibers with LDH, with the inorganic component residing outside the fibers and not exfoliated. At variance the fibers with the LDH-HA showed significantly lower average diameter in the range 350 ± 50 nm, indicating improved electrospinnability of PCL. Moreover the inorganic lamellae were exfoliated, as shown by X-rays and residing inside the nanofibers as demonstrated by Energy Dispersive X-ray Spectroscopy analysis (EDX). The structural parameters, as degradation temperature and crystallinity were investigated for all the samples and correlated with the electrospinning process.

The possibility to introduce LDH with drug molecules makes these composites very attractive for many biomedical fields as membranes and suture threads with controlled release.

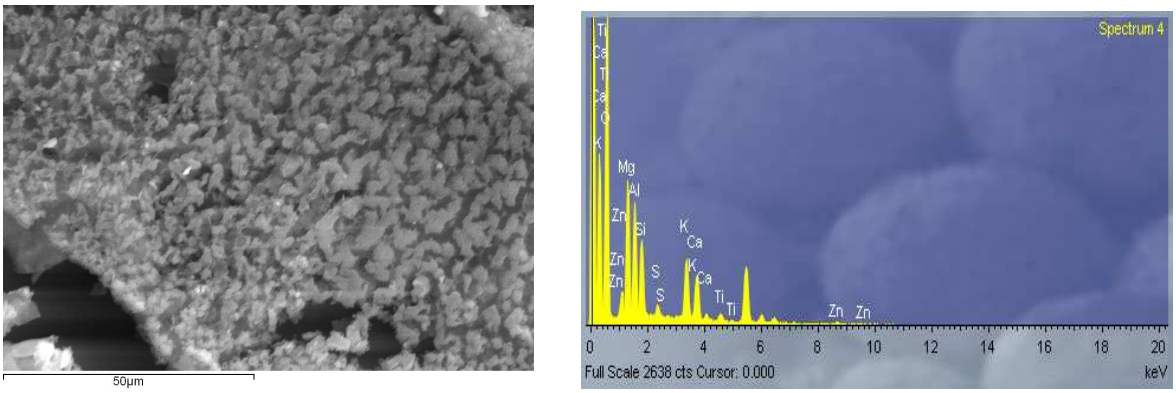

Figure 2: FESEM equipped with an energy dispersive X-ray spectroscopy (EDX) micrographs of composites after thermal oxidation up 450°C of PCL + 5% LDH-HA.

REFERENCES

1. Romeo V., Gorrasi G., Vittoria V., Chronakis I.S. *'Encapsulation and exfoliation of inorganic lamellar fillers into polycaprolactone by electrospinning'. Biomacromolecules,* web release**:** September 7, 2007, DOI: 10.1021/bm700562f