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SEM characterization of gelatin-ionic liquid functional polymers

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ION JELLY® patented technology is based on the cross-linking of Ionic Liquids (ILs) with Gelatin that results in a viscous gel that can be molded into a film or a block, and solidifies by cooling below 35 ºC [1]. The outcome of this combination is a transparent, light and flexible conductive polymer that adapts perfectly to a great variety of surfaces. Some of the key properties of ION JELLY® are: high stability up to 180ºC, large electrochemical window and bio-compatibility [2,3]. Taking in consideration the attractive attributes of ILs, that provide a stable and friendly environment for the enzymes, where they retain their catalytic activity, combined with the morphologic advantage of gelatin, we have decided to study this new protein-ionic-based material regarding water content, swelling behaviour, and structural morphology by scanning electron microscopy (SEM).

The properties of [emim][$EtSO_4$] and [bmim][$N(CN)_2$] ION JELLY® films were compared with those of solely gelatin. Thin films were prepared with different amounts of water or phosphate buffer and left to maturate in a controlled atmosphere for 4 days. Swelling was carried out in water at 4ºC and films were lyophilized afterwards. SEM images of ION JELLY® and gelatin films were obtained prior and after these steps.

ION JELLY® films were rubbery while gelatin films were glassy. Water-made ION JELLY® had completely smooth surfaces, just like gelatin, but buffer-made ION JELLY® exhibited salt crystals on the surface, as well as some superficial pores (Figure 1). Free water content in [emim][$EtSO_4$] ION JELLY® was found to be greater than [bmim][$N(CN)_2$] ION JELLY® and gelatin.

The swelling ratio of both types of ION JELLY® was close to 100%, while gelatin swelled 8 times more. The swollen lyophilized gelatin films formed a heterogeneous and highly porous network (Figure 2), while ION JELLY® films were more homogeneous with a lower degree of porosity (Figure 3).

These results showed that ION JELLY® is a polymer with a more tightly bound structure than gelatin. This material allows water to penetrate, but possesses a higher rigidity that prevents too much mobility of the polymeric chains. Considering that it's a biocompatible polymer, lyophilized swollen ION JELLY® could have potential applications as a scaffold for biological material.

References

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3. Lourenço N.M.T. *et al*., React. Funct. Polym., 71:489-495, 2011.

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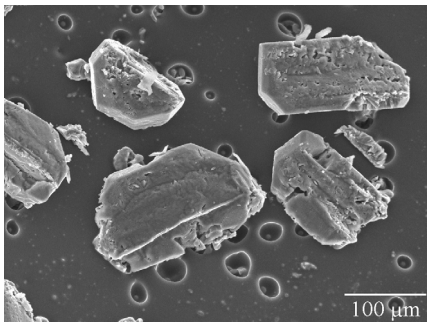

Figure 1. SEM image of [bmim][$N(CN)_2$] ION JELLY® made with sodium phosphate buffer exhibiting salt crystals.

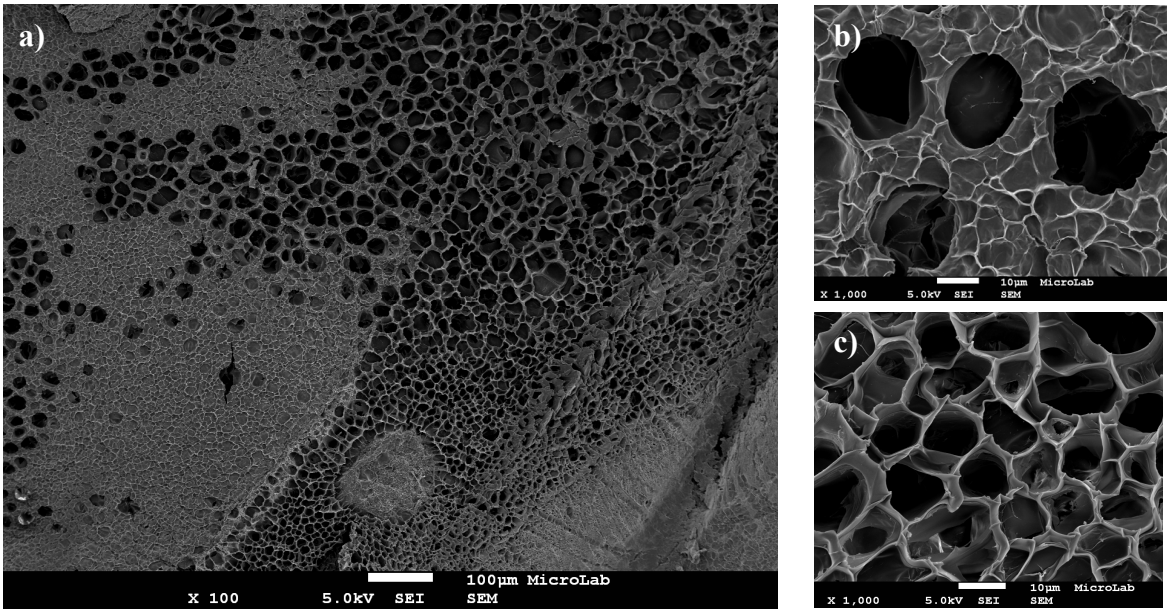

Figure 2. SEM images of lyophilized swollen gelatin films. a) General view; b) and c) Magnified views.

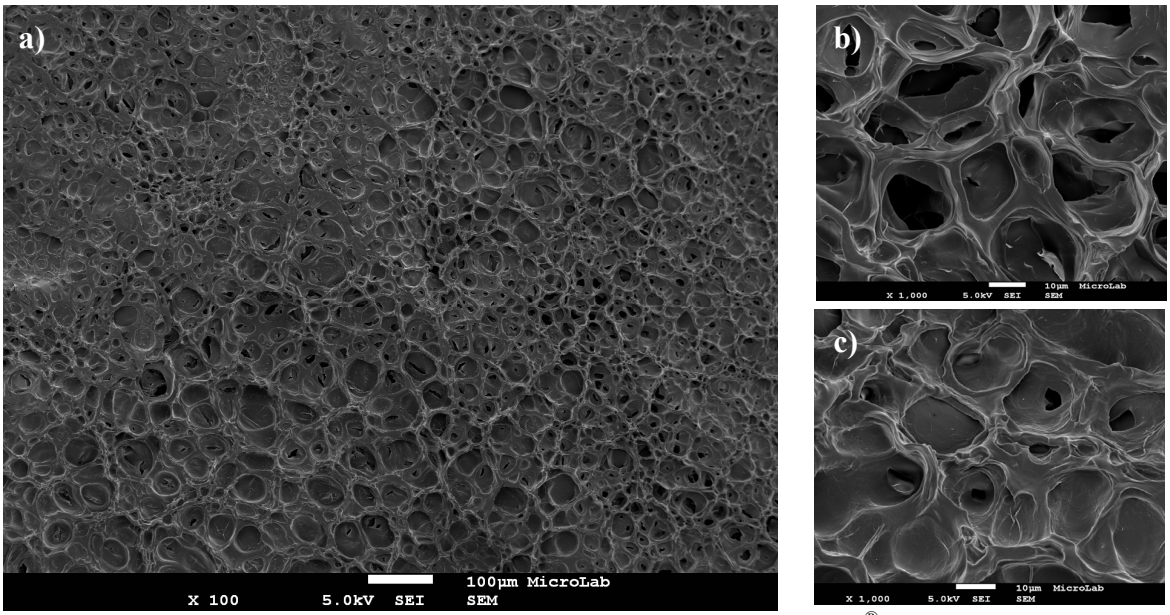

Figure 3. SEM images of lyophilized swollen [emim][$EtSO_4$] ION JELLY® films. a) General view; b) and c) Magnified views.

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