Poly (ε-caprolactone) (PCL) is a hydrophobic, semi-crystalline polymer used in biomedical applications, such as controlled release systems, implantable biomaterials, surgical sutures and dental implants, among other devices that help internal fixation of bone fractures. In this work, different methods of PCL modification in order to improve hydrophilicity by introduction of functional groups on the surface were evaluated. Maleic anhydride (MA) was employed as a chain-end modifier agent. Modified samples were subjected to alkaline hydrolysis in order to increase their hydrophilicity. Polymeric scaffolds were obtained by employing a solvent casting/particle leaching technique, and scaffolds with porosity as high as 85% were obtained, having both open and interconnected pores. Bioactivities tests for PCL after 7 days of immersion in SFB showed that apatite crystals effectively adhere to their surface. Two methods were employed to modify the hydrophilicity of the synthesized polymers. In the first method, polymer samples were immersed in a solution of MA, in THF, in the presence of pyridine as catalyst for 24 hours [1]. The second method was a simple alkaline hydrolysis of the samples by immersion in a NaOH solution during 8 or 20 h at room temperature. Interconnected porous membranes were prepared by solvent casting and particulate leaching by dissolving in chloroform (20 wt %) using NaCl as porogen [2]. Bioactivity of the scaffolds was studied in a phosphate buffered saline (PBS) at pH 7.4 to simulate in vivo conditions [3]. Figure 1(a) shows a cross-section of the scaffolds obtained where a highly and interconnected porous membrane can be observed. Internal photographs of the cross-section after immersion in SFB are shown in figures (b and c). In Fig. 1(b) apatite crystals can be found on the scaffold’s surface, whereas in Fig. 1(c) no apatite crystals appeared on the neat PCL scaffold. Chemical modification of PCL with MA yielded PCL samples bearing COOH groups at the chain-end. Porous scaffolds were prepared with open and interconnected pores ranging in size from 50 to 150 µm. Bioactivities tests after 7 days immersion in SFB showed apatite crystals growing on the surface of the scaffolds prepared using modified PCL. These results suggest that chemical treatment provides a polymer surface with nuclear precursors for apatite deposition.

References.

Acknowledgement: We express our gratitude to the Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina (CONICET, Argentina) for the financial support.
Fig. 1: (a) SEM photograph of the cross-section of a PCL scaffold. Internal surface of the PCL scaffold after 7 days of immersion in SBF: (b) PCL modified with MA, and (c) neat PCL.