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Imaging of Bio-Compatible Polymers in the Helium Ion Microscope

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Bio-compatible polymers are finding applications within the field of regenerative medicine because of their ability to support tissue growth [1]. In some applications, the polymer is in the form of a flat film substrate onto which cells and minerals are grown. In other cases, the polymer is pre-structured into a three dimensional "synthetic scaffold" structures in order to facilitate penetration of bio-fluids. [2] Some of the preferred materials include chitosan [3], PLLA (Poly L-lactide) and PLGA (Poly lactide/glycolide) [4]. The focus of this study is the imaging of bio-compatible polymers with the newly introduced helium ion microscope (HIM) [5].

In several respects, the helium ion beam interacts with the polymers in a manner that is very different from an electron beam. First, the helium ions generate mostly "type 1" secondary electrons (SE1) [5],[6] due to the very low rate of helium backscattering. The SE1 signal conveys the most surface-specific information, and the narrowest lateral width. Second, the helium ion microscope primarily produces a surface charge distribution, with relatively little sub-surface charging. For insulators, the residual surface charge can be balanced with a low energy electron flood gun. Using a conventional SEM, the electron beam deposits charge under the surface, where it is not readily dissipated or neutralized. Finally, the focused helium ion beam provides a much longer depth of focus, providing sharp image information deep within the three dimensional scaffolding structures.

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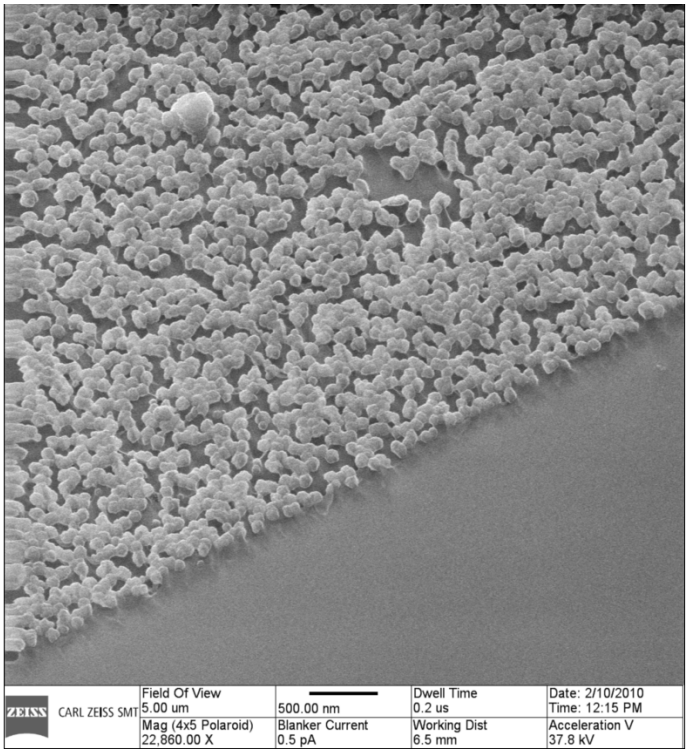

Figure 1: Helium ion microscope image of hydroxyapatite minerals (a bonelike mineral) grown on the PLLA substrate. The Field of view is 5 μm.

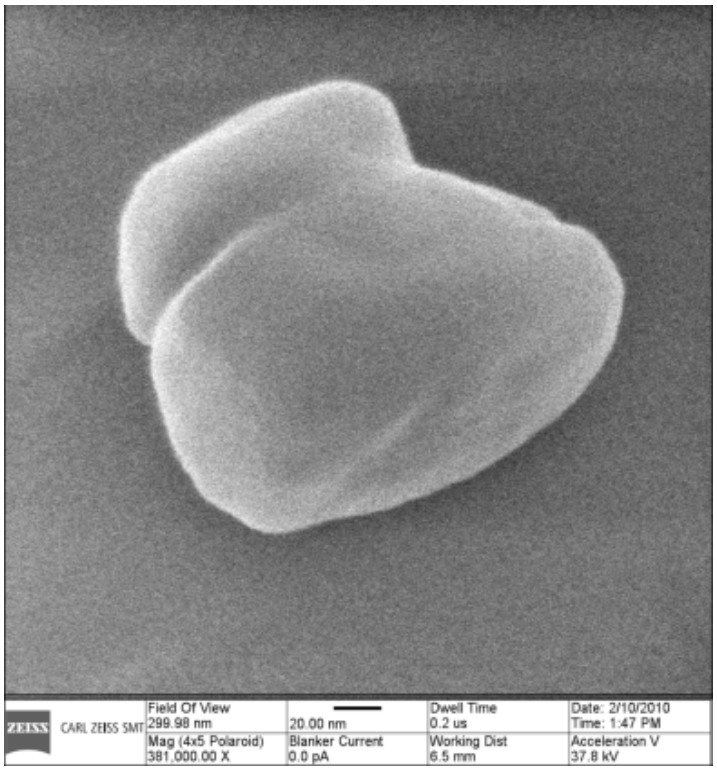

Figure 2: High magnification image of the hydroxyapatite mineral using the helium ion microscope. The field of view here is 300 nm.

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