Three dimensional visualization of engineered bone and soft tissue by combined x-ray micro-diffraction and phase contrast tomography

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Computed X-ray phase contrast micro-tomography is the most valuable tool for a three-dimensional and non destructive analysis of the tissue engineered bone morphology. We used a Talbot interferometer for a precise 3D reconstruction of both bone and soft connective tissue, regenerated in vivo within a porous scaffold. For the first time the X-ray tomographic reconstructions have been combined with X-ray scanning micro-diffraction measurement on the same sample, in order to give an exhaustive view of the role of the different tissues participating to the biomineralization process. In particular our experimental approach allows for a deeper understanding of the role of collagen matrix in the organic-mineral transition, which is a crucial issue for the development of new bio-inspired composites.

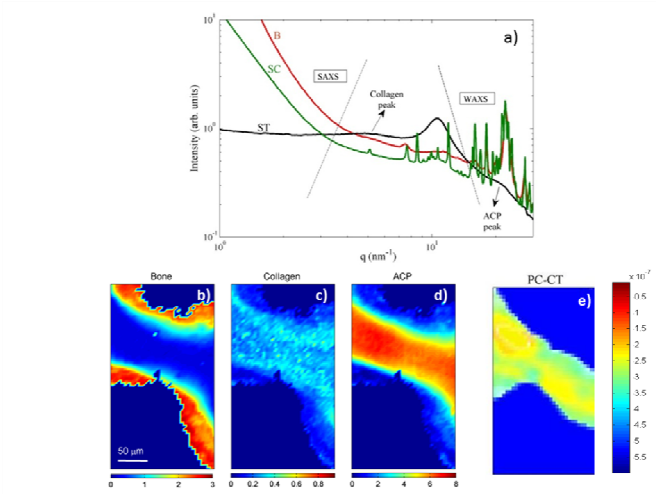

Figure 1. a) Diffracted intensity, collected in different positions, indicating three different tissues, namely soft tissue (ST), due mainly to the collagen fibres, scaffold (SC) and newly formed bone tissue (B).From integration we obtained the spatial distribution of the bone, collagen and ACP, shown in figure 1b, 1c, 1d respectively. Figure 1e is the δ (real part of the refraction index) distribution image obtained by the tomographic reconstruction.