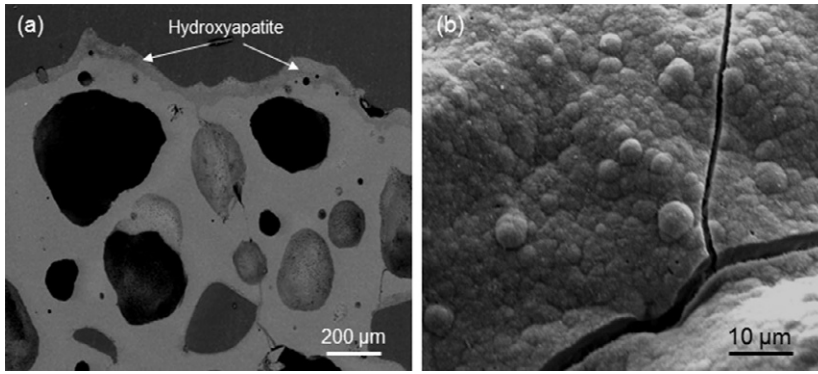

FIG. 16.12 Hydroxyapatite layer formed on scaffold struts after soaking for 7 days in SBF: (A) SEM micrographs of a scaffold cross section acquired in back-scattered mode; (B) surface detail of the hydroxyapatite layer.

adopted for SEM analysis emphasizes the presence of the hydroxyapatite layer grown on scaffold walls, as indicated in the picture. The newly formed layer is compact, homogeneous, and continuous and constitutes a thick "skin" (20–50 µm) on scaffold struts. Fig. 16.12B illustrates the typical "cauliflower" morphology of the hydroxyapatite agglomerates grown on scaffold walls. The two cracks visible in the picture are due to the condensation and repolymerization of Si–OH groups during the early stages of the bioactive process (Hench et al., 1972).

The presence of a hydroxyapatite layer on scaffold struts plays a key role for promoting the graft colonization by bone cells, as it was demonstrated that osteoblasts attach preferably on apatite crystals due to their chemical and crystallographic similarity to bone mineral (Ozawa et al., 1989; Thomson et al., 1998). Therefore, the surface apatite layer can impart biomimetic properties to the scaffolds, making the implant surface a biocompatible substrate apt for cell adhesion.

16.4. CONCLUSIONS

The development of functionally graded scaffolds is a highly challenging field of research that is still largely unexplored. Using bioinspired approaches should drive scientists in the design and manufacturing of these high-added-value structures (Baino and Ferraris, 2017). Bioactive glasses are ideal materials for fabricating hierarchical scaffolds, and there is evidence that 3D glass-derived bilayered constructs mimicking the cancellous-cortical bone system can be successfully obtained by combining different methods of fabrication, such as polyethylene burn off and sponge replication. Their use in bone reconstructive surgery is highly promising due to the possibility of tailoring key properties, such as shape, size, porosity, and mechanical strength, in a controlled way to