Abstract #1063 | Oral

# Bioactive glasses-based biomaterials with potential in soft tissue engineering

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**Introduction:**
Silicate-bioactive glasses have been extensively studied for bone tissue engineering. The "traditional" bioactive glasses (i.e. 45S5 and S53P4) have found space in clinics: from bone filler to ocular implants. The benefit of using bioactive glasses, lies in the ability to tailor the composition to control the dissolution/reaction rate or thermal properties (fiber drawing, scaffold sintering). More importantly, the ease to incorporate ions of therapeutic interest has led to remarkable discoveries. Indeed, control release of strontium, zinc, magnesium, silver, copper or boron, just to cite a few, has enable to process materials with excellent osteogenesis, angiogenesis or antimicrobial properties [1]. However, while bioactive glasses, in bone related applications, was promising, the difficulties in shaping the grafts into the exact patient's defect has, to some extent, limited their clinical use. Nevertheless, it appears clear that the unique properties of bioactive glasses are still of interest. Indeed, researchers are constantly studying their potential use in composites or hybrid biomaterials [2].

While many questions remain to be answered to better grasp the full potential of bioactive glasses in hard tissue regeneration, some researchers already devoted their energies to explore new avenues for such uniquely tailorable material. For instance, researchers have explored the potential of bioactive glasses in soft tissue regeneration. For example, tubular phosphate glass fibres have been found to give a promising alternative to end-to-end suturing in facial nerve reconstruction [3]. More recently, borate bioactive glass nanofibers (Mirragen™) has proved to be excellent in treating long-term venous stasis ulcer in diabetic patients who were irresponsive to conventional treatments [4].

These new results are opening new horizons for the use of bioactive glasses in clinics.

**RESULTS AND DISCUSSION:**
In the recent years our work has focused on designing materials that, not only could be applicable to hard tissue engineering but also soft tissue. In order to develop innovative construct; able to not only support, but also trigger, soft tissue regeneration a survey study where bioactive glass (13-93) extract was performed to culture various cell types (adipose stem cells, lung fibroblasts, or uroepithelial cells). The hASCs and the WI fibroblasts remained viable in the extracts. Li and Sr appeared to have positive impact on the cell's proliferation. However, the high Ca concentration inhibits the proliferation of UE cells.

Tubular structures (PLA/bioactive glasses) were efficiently produced with a controlled porosity (>50%) and pore size ranging from 100 to 400 µm (Fig 1). The glass (13-93) dispersion was found to be homogeneous within the structure. The glass loading (25-35 wt%) was consistent with the target loading. The presence of bioactive glass allowed to prevent acidification of the environment while contributing to the faster degradation of the polymer matrix. Hybrid biomaterials (wood based nanofibrils and bioactive glasses or gelatin/GPTMS/bioactive glasses) were also developed into inks for bioprinting. In this study we demonstrated the possibility to develop an ink that can be printed into the shape of a mandible (Fig.2) while maintaining cell viability. Composites and hybrids could have potential for nerve regeneration, urethra or trachea repair.

Finally, while ions can trigger signalling pathways leading to osteogenesis or angiogenesis, in recent years the use of light to direct tissue healing as gained increasing interest. As such, biophotonic bioactive glasses were develop. While their characterization is only starting, the ability to design material with persistent luminescence in wavelength ranging from UV to NIR has high potential in tissue engineering. Indeed, it was shown by Liu et al. that micro-patterned light emission can enable to orientate cells and create anisotropic cell sheets, thus mimicking the complex structure of soft tissue such as muscles, artery, and nervous system [5]

**Conclusion:**

Bioactive glasses have been widely studied in hard tissue reconstruction. However, their potential in soft tissue is nowadays being investigating. Bioactive glass, when combined with natural or synthetic polymeric matrices, enables to design materials for a wide range of application (from restoring the nervous system to healing urethra defects). The benefit of ions released from the bioactive glass is undeniable. Combining controlled ion release, biophotonic and tissue engineering may open the door to significant breakthrough in soft tissue regeneration.

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**Affix**

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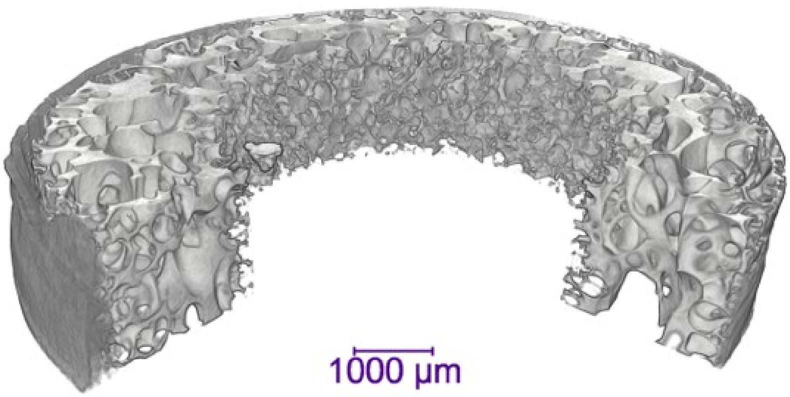


Figure 1: µCT 3D reconstruction of a PLA/13-93 composite scaffold foamed by $ScCO_2$

**µCT 3D reconstruction of a PLA/13-93 composite scaffold foamed by ScCO2**

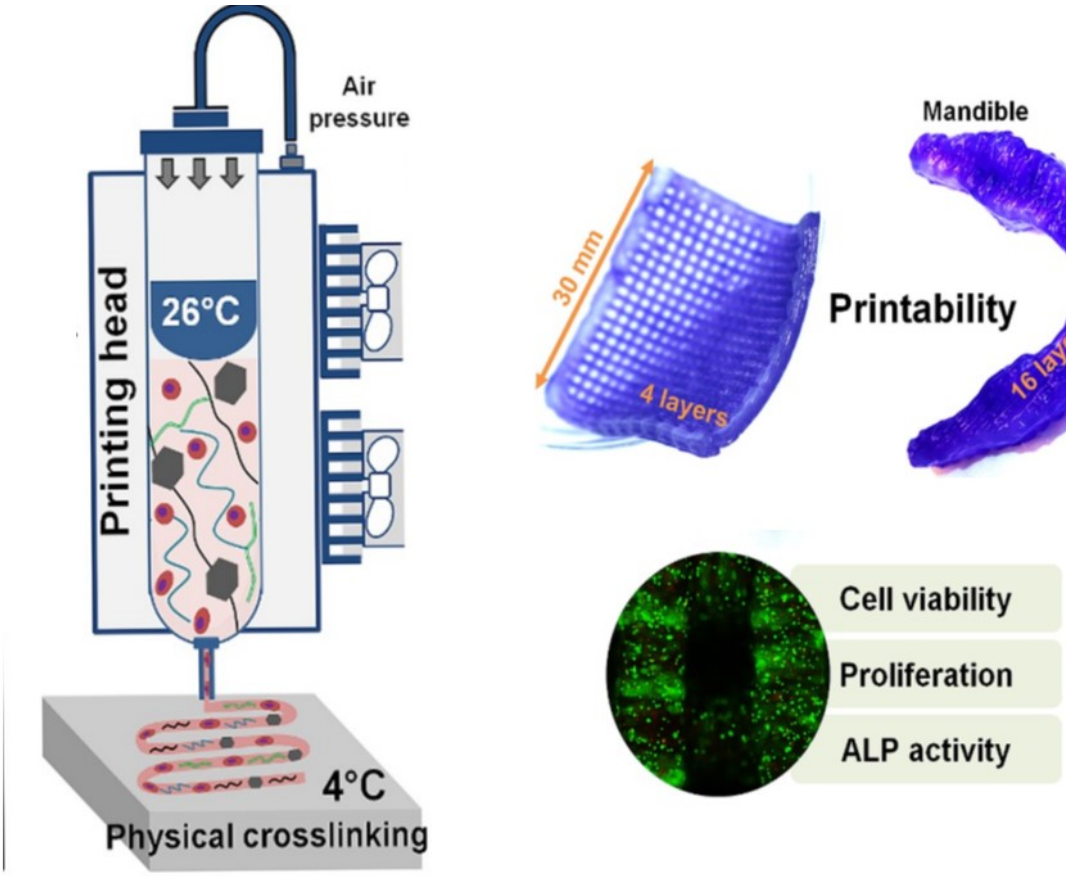


Figure 2: Printing of a gel containing bioactive glass particles as well as cells, into a mandible shape

**Ptinting of a gel containing bioactive glass particles as well as cells, into a mandible shape**