Design Optimization, Characterization, and Bioactivity Assessment of nanocomposite scaffold

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**Statement of Purpose:** Bioactive glasses were used extensively as an orthopedic grafting material. Reducing the particle size of materials to nanosize was shown to improve their biological properties. Moreover, aliphatic polyesters are not suitable for bone regeneration, as they are not bioactive. Therefore, the main objectives of the present study were to prepare sol-gel bioactive glass nanoparticles and to engineer nanocomposite scaffold consist of glass nanoparticles and poly(DL-lactide-co-glycolide) with improved bioactivity for bone engineering application

**Methods:**

Material preparation:

Sol-gel bioactive glass nanoparticles were synthesized using an alkali-mediated sol–gel method as reported previously (1) then bioactive glass/poly(DL-lactide-co-glycolide) nanocomposite scaffolds were developed using gas foaming and salt leaching techniques as described elsewhere (2). The code of the scaffolds and their glass contents are presented in Table 1

*Table1. Scaffolds code and their glass content*

| scaffold code | Glass content (wt%) |
|---|---|
| PLGA | Neat polymer scaffold |
| PLGA10% | 10wt% |
| PLGA30% | 30wt% |

Materials characterization;

The scaffolds were characterized by scanning electron microscopy coupled with energy-dispersive x-ray analysis (SEM/EDXA), *In vitro* degradation tests were carried out in phosphate buffer saline (PBS) (pH 7.4) at 37 °C. The water uptake and weight loss of the scaffold incubated in the PBS were measured at different time periods. The in vitro bioactivity of the scaffolds was determined by soaking the samples in simulated body fluids (SBF) at 37 °C for various periods of time. The formation of a hydroxyapatite layer on the surface of the scaffolds was verified by using scanning electron microscopy coupled with energy-dispersive x-ray analysis (SEM/EDXA) and thin-film x-ray analysis (TF-XRD).

**Results:**

SEM: Examination of the SEM microphotographs revealed that the all the scaffolds had a highly interconnected porous structure with a maximum pore size value of about 100 µm. See figure (1).

Degradation study: The water absorption of the scaffolds increased by increasing their glass content. It reached to 68.13, 85.32 and 189.81% for PLGA, PLGA10% and PLGA30% respectively after three days in PBS. The weight loss of the scaffolds increased by increasing the glass content. It was 9.11, 17.52 and 20.66% for the PLGA, PLGA10% and PLGA30% respectively after three days in PBS.

In vitro bioactivity: The composite scaffolds were able to induce the formation of hydroxyapaptite layer on their surfaces as verified by SEM and TF-XRD

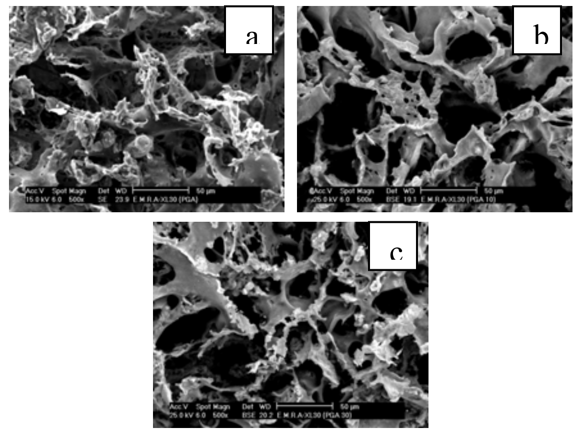


**Fig (1):** SEM microphotographs of PLGA (a), PGLA10% (b) and PGLA%30 (c)

**Conclusions:**

The results obtained from this work indicated the possibility to modulate the degradation rate of the composite scaffolds, and to improve their bioactivity by varying their glass content, demonstrating their potential application in bone engineering.

**References:**

1. Wei. X, J. Jiang C, Materials Letters (2007) 61: 3251.
2. Gilson K, Moon S. K, Hai B. L, A manual for biomaterials scaffold fabrication technology, World Scientific, 2006.