Smart Biomaterial Scaffolds for Tumour Suppression and Bone Tissue Regeneration

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Bone cancer treatment requires therapeutic solutions capable of eliminating residual tumour cells while simultaneously promoting bone regeneration.[1,2]

At CICECO – Aveiro Institute of Materials, we have developed multifunctional chitosan-based scaffolds that integrate magnetic, electroactive and biochemical cues to address these dual challenges.

One strategy involves magneto-responsive scaffolds incorporating nano-hydroxyapatite, magnetite nanoparticles and fucoidan. These structures exhibit high porosity (>80%), suitable mechanical strength (~0.5 MPa), and support Saos-2 proliferation and early osteogenic activity. Under alternating magnetic fields, the scaffold reach therapeutic temperatures (~42 °C) that reduce cell viability to 30%, while fucoidan provides a complementary chemotherapeutic effect, decreasing clonogenic survival by 75%.

Another strategy focuses on electroactive chitosan/nHA scaffolds integrating a conductive carbon–sepiolite composite and ZnO nanoparticles. These porous structures (70–85%) generate reversible dielectric responses under mechanical stimulation, support cell viability and matrix deposition, and show enhanced bioactivity when exposed to low-intensity pulsed ultrasound.

Together, these multifunctional systems illustrate a promising materials-based approach that uses hyperthermia, electrostimulation and biochemical signalling to suppress cancer cells while promoting bone tissue regeneration.

Reference

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[2] 2. Zhang, Y.; Wu, Y.; Qiao, X.; Lin, T.; Wang, Y.; Wang, M. Front Mater (2022), 9.

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Figures

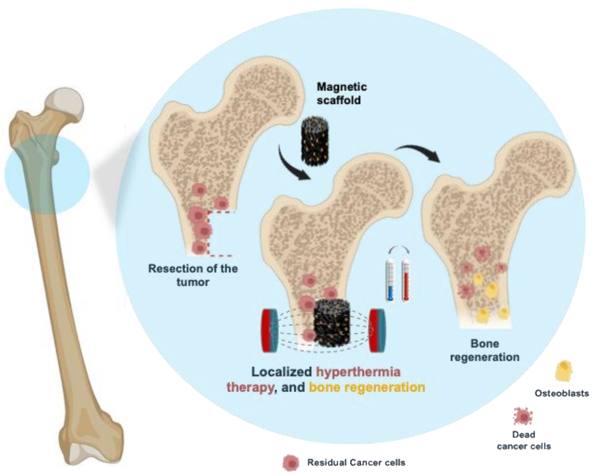

Figure 1. Multifunctional chitosan-based porous scaffold to mimic bone´s bioelectric environment and promote bone regeneration

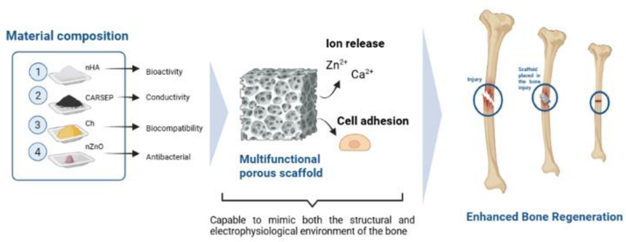

Figure 2. Multifunctional chitosan-based porous scaffold to mimic bone´s bioelectric environment and promote bone regeneration