Development of bactericidal nanopillar topographies in Calcium Phosphates

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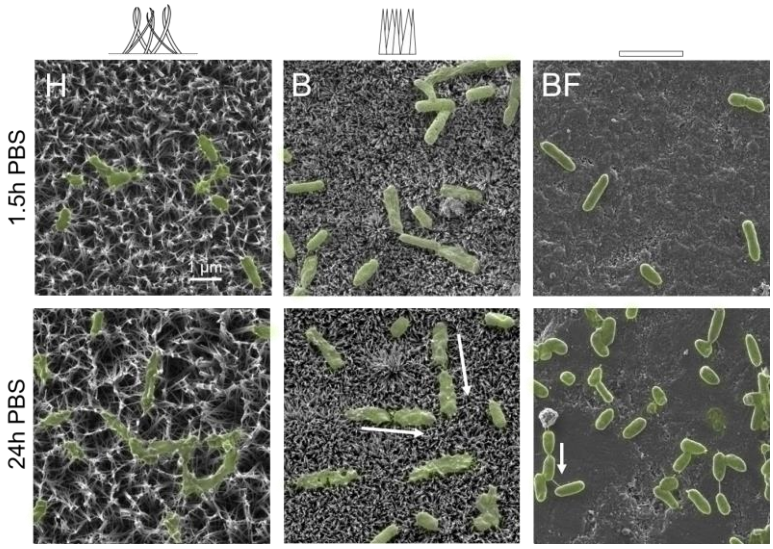
ABSTRACT

Calcium deficient hydroxyapatite (CDHA) is a biomaterial of great interest for bone regeneration. However, it is not intrinsically bactericidal and when implanted inside the body it exists a risk of infection. One way to endow CDHA with antimicrobial properties is to modify its surface with nanopillars to induce bacterial membrane disruption. Several strategies can be used to synthesize nanopillared CDHA, for example, by modifying the hydrolysis reaction of α-tricalcium phosphate (α-TCP). In order to analyse and understand better the effect that have the reaction conditions in the morphology of the pillars a design of experiments (DOE) was performed. The reaction factors tested were the powder grinding protocol of the α-TCP (long or short ball milling), particle size, consolidation reaction (different temperatures and pressures) and the addition of nucleating agents. The results showed that the consolidation reaction had the most significant impact on the morphology of the formed pillars. A wide range of interpillar values from 100 nm to 1100 nm was obtained. Additionally, a second strategy to tune the size and morphology of the pillars was investigated by modifying the hydrolysis pH using different salt dilutions (NaH_2PO_4, Na_2HPO_4, Na_3PO_4). Higher pH values resulted in the formation of smaller pillars and lower pH resulted in the modification of the morphology of the nanopillars into nanoplates. The most relevant topographies were tested *in vitro* against *Pseudomonas aeruginosa* demonstrating up to 80% of lethality after 24 hours.



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