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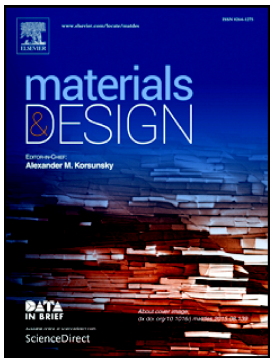

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Generation and Characterisation of Gallium Titanate Surfaces through Hydrothermal Ion-Exchange Processes

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Abstract

Infection negation and biofilm prevention are necessary developments needed for implant materials. Furthermore, an increase in publications regarding gallium (Ga) as an antimicrobial ion has resulted in bacterial-inhibitory surfaces incorporating gallium as opposed to silver (Ag). The authors present the production of novel gallium titanate surfaces through hydrothermal ion-exchange reactions. Commercially-pure Ti (S0: Cp-Ti) was initially suspended in NaOH solutions to obtain sodium titanate (S1: Na_2TiO_3) layers ca. 0.5–1 μm in depth (2.4 at.% Na). Subsequent suspension in $Ga(NO_3)_3$ (S2: $Ga_2(TiO_3)_3$), and post-heat-treatment at 700 ^oC (S3: $Ga_2(TiO_3)_3$-HT), generated gallium titanate layers (9.4 and 4.1 at.% Ga, respectively). For the first time, RHEED analysis of gallium titanate layers was conducted and demonstrated titanate formation. Degradation studies in DMEM showed S2: $Ga_2(TiO_3)_3$ released more Ga compared to S3: $Ga_2(TiO_3)_3$-HT (2.76 vs. 0.68 ppm) over 168 h. Furthermore, deposition of Ca/P in a Ca:P ratio of 1.71 and 1.34, on S2: $Ga_2(TiO_3)_3$ and S3: $Ga_2(TiO_3)_3$-HT, respectively, over 168 h was seen. However, the study failed to replicate the antimicrobial effect presented by *Yamaguchi* who utilised *A. baumannii,* compared to *S. aureus* used presently. The authors feel a full antimicrobial study is required to assess gallium titanate as a candidate antimicrobial surface.

Keywords: biomaterial; sodium titanate; gallium titanate; hydrothermal; ion-exchange; titanium.