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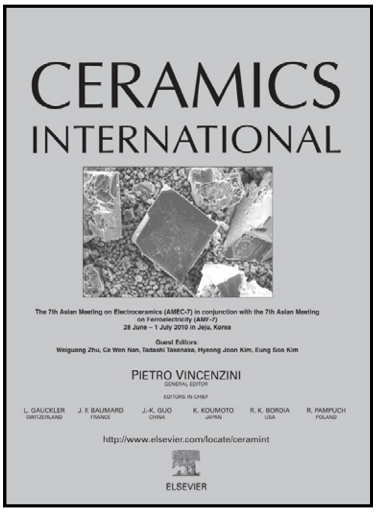


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# Thermal Stability of Electrochemical-Hydrothermal Hydroxyapatite Coatings

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**Abstract**

Dense, uniform hydroxyapatite (HA) coatings were synthesized by hydrothermal crystal growth onto titanium substrates that were electrochemically seeded with HA nanocrystals. The HA was also doped with yttrium and/or fluoride during the hydrothermal reaction. The resulting HA coatings have a unique morphology consisting of crystal domains aligned with the crystallographic *c*-axis oriented normal to the surface of the coating. At elevated temperatures, the HA coatings were found to slowly decomposes via dehydroxylation to β-tricalcium phosphate (β-TCP). Thermal decomposition negatively impacts the mechanical stability of the coating and can negatively impact performance *in vivo* due to the higher solubility of β-TCP relative to HA. It is shown that thermal decomposition of HA membranes can be avoided by adding water vapor to suppress dehydroxylation during thermal processing, or by doping the membrane with fluoride during hydrothermal synthesis. Thermal decomposition of HA coatings to β-TCP was characterized by X-ray diffraction and scanning electron microscopy. Coatings of HA or yttrium-doped HA were found to be unstable in dry air above 600 °C, but stable in a steam atmosphere at 900 °C. Coatings doped with fluoride or co-doped with yttrium and fluoride were also thermally stable in dry air at 900 °C. Therefore, the unique HA coating morphology and composition can be maintained during post-synthesis thermal processing or high temperature applications.

*Keywords:*
Hydroxyapatite, Hydrothermal, Thermal stability, Fluoride

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