# Influence of Strontium Substitution for Calcium on the Apatite Formation Ability of Chloride-Containing Bioactive Glasses

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**Abstract**

Chloride-containing bioactive glasses (BGs) were found to be highly degradable and form apatite rapidly, therefore, they are useful for medical and dental applications. Strontium is an attractive component to be incorporated into BGs and is known to up-regulate osteoblasts and down-regulate osteoclasts. The Sr2+ cation is slightly larger than the Ca2+ cation, the substitution of strontium for calcium results in an expansion of the glass network and a faster glass dissolution that might lead to a faster apatite formation. However, recently, it was shown that strontium substitution for calcium in fluoride-free BG inhibited the formation of apatite when immersed in Tris buffer. The objective of this work is to investigate the influence of strontium substitution for calcium on the apatite forming of chloride-containing BGs.

A series of chloride-containing BGs were produced by progressively substituting strontium oxide for calcium oxide. Glass thermal properties were characterized by differential scanning calorimetry. A chloride ion select electrode was used to measure the retention of chloride in the initial compositions. The apatite formation capability on dissolution of the glasses in Tris buffer was followed by X-ray Diffraction, Fourier Transform Infrared and Nuclear Magnetic Resonance spectroscopy. Dissolution studies were followed by the ion release measurements. It was found that all the studied glasses partially crystallized to chlorapatite-like phases. The chloride content measurements reveal that most of chloride (around 70%) was retained in the studied Q2 type silicate glasses. The results of the in vitro studies show that strontium substitution for calcium suppresses apatite formation in chloride-containing BGs. This is probably a result of strontium not being able to substitute completely for calcium in octacalcium phosphate, which is a precursor phase for hydroxycarbonated apatite formation. Strontium retards the formation of octacalcium phosphate therefore hindering the formation of an apatite-like phase.

**Keywords:** bioactive glasses, chloride containing, apatite, strontium substitution, highly degradable

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