Chapter 1

Bioactive Glass Containing Coatings by Electrophoretic Deposition: Development and Applications

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1.1 INTRODUCTION

Bioactive glasses (BGs) exhibit the capability of forming strong physical and chemical bonds with living tissue (Hench, 2015). These surface-active materials bond with soft and hard tissue through the formation of hydroxycarbonate apatite. The numerous biomedical applications realized and proposed for BGs have been discussed in the literature (Fagerlund, 2017; Miguez-Pacheco et al., 2015; Hench and Paschall, 1973; Montazerian and Zanotto, 2017; Hupa, 2011; Brauer and Möncke, 2017); most applications being related to the skeletal system, for example, as small implants in nonload-bearing applications, bone filler and scaffolds to promote new bone tissue formation, and in dentistry, although applications in soft-tissue repair are emerging (Miguez-Pacheco et al., 2015).

The first BG was invented by Hench et al. in the late 1960s (Hench and Paschall, 1973). This BG, well-known as 45S5 Bioglass, is a melt-derived glass in the Na_2O-CaO-P_2O_5-SiO_2 system, which contains thus elements which are present in the human body, specially Ca and P are abundant in bone tissue, making BG 45S5 ideal for bone regeneration. In general, BGs show a rapid initial dissolution of the alkaline elements from the surface which is followed by a precipitation of a Ca- and P-rich layer on top of the alkali-depleted SiO_2 layer, forming hydroxycarbonate apatite, the mineral phase of bone (Fagerlund, 2017).

In the last 45 years, different BGs have been developed and the production method has been extended to sol-gel glasses, requiring lower temperature during synthesis, while resulting in particles with smaller size distribution and higher

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