In AC fields, the particle charge periodically reverses its direction between the positive and negative electrode. Hence, an asymmetrical field is required in order to move the particles in a favored direction. With the help of alternating current EPD, smooth and thick films of biological entities can be obtained without damage (Seuss and Boccaccini, 2013) and, for example, carbon nanotubes can be oriented in the direction of the electric field (Chávez-Valdez and Boccaccini, 2012). Compared to constant DC-EPD the deposition rate in AC-EPD is low, but the quality of the coated layers is in general better as no gas bubbles remain incorporated in the coatings, avoiding the formation of pores (Ammam, 2012).

1.3 BIOACTIVE GLASS COATINGS

BGs cannot be applied in a load-bearing application as they exhibit a low flexural strength and limited structural integrity under tension. However, BGs, as mentioned above, can be coated on metallic substrates in order to exploit the toughness of the metal and the bioactive behavior of the glass (Krause et al., 2006).

Pure BG coatings for medical applications produced by EPD are discussed in this section. In an early study, Krause et al. (2006) achieved a smooth and uniform 45S5 BG coating on top of stainless steel and shape-memory (Ni-Ti) wires. BG particles in water exhibit a negative surface charge and are therefore anodically deposited. The coating was sintered to achieve densification by viscous flow. Braem et al. (2012) used isopropanol as the solvent to achieve a positive surface charge of BG particles, enabling a cathodic deposition on Ti-6Al-4V discs. After sintering, a fully crystallized BG coating was achieved. Furthermore, the authors showed the feasibility of coating dental implants by EPD (see Fig. 1.4). However, Radice et al. (2007) mentioned the unfavorable effect of using metallic substrates as the anode during deposition, as uncontrolled pitting and oxidation of the substrate may occur. One way to tackle this limitation is to use a solvent in which BG particles are charged positively or by adjusting the pH of aqueous suspensions. Mehdipour et al. (2012) used triethanol amine to increase the zeta potential in order to gain a higher stability of the suspension. Faure et al. (2015) utilized EPD as the method of choice for their Ti_6Al_4V substrate, previously subjected to Surface Mechanical Attrition Treatment (SMAT) in order to improve the mechanical properties, especially the adhesion of the coating to the substrate. However, the achieved surface roughness of SMAT was too low to provide a good mechanical adhesion. EPD succeeded in depositing 56 wt% SiO_2-36 wt% CaO-8 wt% P_2O_5 BG particles to form an adherent and homogeneous coating on Ti_6Al_4V alloy substrates (Faure et al., 2015).

Besides pure BG coatings, sequential depositions of other materials can be performed to enhance the properties of the BG coating. Cho et al. (2009) for example, employed a 45S5 BG coating on stainless steel, followed by an