adverse effects on the environment. The possible mechanism of the biocide action of these glasses has been clarified by the same author (Moya et al., 2012) and correlated to the lixiviation of Ca^{2+} ions, which takes place at an enhanced rate in borosilicate glasses in comparison to common soda-lime ones. The bactericidal activity of such glasses seems to be strongly related to their ability to lixiviate Ca^{2+} at the glass-bacteria interface, leading to membrane depolarization and the consequent death of the cell.

The antibacterial properties of bioactive glasses can also be induced or improved by the addition of metal ions with well-known bactericidal effect. Several ions have been investigated for this application and their efficacy has been evidenced against several bacterial strains and yeast. In most cases, the antibacterial effect of the bioactive glasses doped with various ions was achieved without affecting their safety.

Silver is one of the most studied antibacterial ions and silver-containing bioactive glasses have been developed by several authors by different synthesis routes: ion exchange in molten salts or in aqueous solutions (Di Nunzio, n.d.; Vernè et al., 2005; Di Nunzio et al., 2005, 2004; Catan et al., 2008), melting (Xu et al., 2008), sol-gel (Kawashita et al., 2000), or by surface functionalization with silver nanoparticles (Taglietti et al., 2014). Ag-doped bioactive glasses always showed a high inhibitory effect on bacteria growth. However, it is difficult to control the amount of silver required to achieve antibacterial effects without affecting the glass biocompatibility. Only limited data are reported in the literature concerning the correlation between silver content, the amount of silver ions released by the material surface and their eventual toxic effect. For example, Vernè and Di Nunzio (Di Nunzio, n.d.; Vernè et al., 2005; Di Nunzio et al., 2004, 2005) adapted the ion exchange process to introduce silver ions only onto the surface of bioactive glasses. The ion exchange conditions (in molten salts or in aqueous solution) have been optimized in order to minimize the amount of silver added into the surface of glass, to impart the antibacterial action without inducing cytotoxicity. This work showed that the ion exchange method was suitable for a calibrated enrichment of bioactive glass surfaces with silver ions, achieving silver leaching in the biological fluids below the clinical tolerances, without lowering the glass bioactivity. It was also established that the silver released from bioactive glasses could contribute to the bioactivity mechanism, enhancing hydroxyapatite growth.

The higher reactivity of silver-doped glasses in comparison to the undoped formulation is not surprising, taking into account the studies of Catan et al. (2008), who used both infrared spectroscopy (FTIR) and scanning electron microscopy (SEM) techniques to describe the effect of the Ag^{+}-Na^{+} ion exchange on silica-based glasses. In this work, it was argued that the insertion of Ag^{+} induced a weak modification in the glass structure, leading to depolymerization of the silicate network.

The conventional melt-quenching method used for the realization of silver-doped bioactive glasses has attracted investigation as it cannot ensure controlled