

# Mesoporous Bioactive Glasses: Fabrication, Structure, Drug Delivery Property, and Therapeutic Potential

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## 4.1 INTRODUCTION

Bioactive glasses (BGs) as attractive biomaterials have been widely used for bone tissue regeneration and replacement since Hench et al. firstly developed the 45SiO<sub>2</sub>-24.5Na<sub>2</sub>O-24.5CaO-6P<sub>2</sub>O<sub>5</sub> system (45S5 Bioglass) in the 1970s (Hench et al., 1971; Bairo et al., 2016). The BGs can bond chemically with host tissues and promote new bone growth (Hench, 1991). When BGs are implanted in bone defect sites, they may degrade gradually over time and the released ions simulate the deposition of carbonated hydroxyapatite (CHA) on their surfaces (Yan et al., 2004, 2006). The enhanced CHA formation activity of BGs is related to the SiO<sub>2</sub> network by the formation of nonbridging silicon-oxygen bonds (Yan et al., 2004, 2006). Under proper doses, the BGs are shown to stimulate cell responses and accelerate acellular mineralization (El-Fiqi et al., 2013; Park et al., 2014).

To date, BGs-based composites have been fabricated for treating bone defects due to trauma, bone disease, and surgical resection (El-Fiqi et al., 2015). Notably, the risk factors associated with poor bone-forming activity still occur in bone defects, especially for the patients with local osteoporosis, metabolic bone disorders, and diabetes (Yan et al., 2006). The common BGs possess osteoconductivity, but do not have osteoinductivity (El-Fiqi et al., 2015). The loading of cytokines such as the vascular endothelial growth factor (VEGF), platelet-derived growth factor (PDGF), bone morphogenetic protein-2 (BMP-2), and dexamethasone (DEX) on carriers is a promising method to enhance osteogenic ability (El-Fiqi et al., 2015; Zhang et al., 2013; Schumacher et al., 2017;