

Wu and Chang, 2014). As compared with nonmesoporous BGs (NBGs), the mesoporous BGs (MBGs) are more appropriate for drug delivery systems because of the ordered mesoporous structure, large surface area, and great pore volume (Chen et al., 2017; Wang and Li, 2016; Sui et al., 2016). In 2004, Zhao et al. for the first time prepared the MBGs by the sol-gel method using nonionic block copolymers as structure-directing agents through an evaporation-induced self-assembly (EISA) process (Yan et al., 2004). Within the MBGs, the ordered mesopores with pore sizes ranging from 2 to 50 nm can serve as drug delivery channels for loading drug molecules and controlled release (Chen et al., 2017; Wang and Li, 2016; Sui et al., 2016). The long-term controlled release of various growth factors or osteogenic drugs from the BGs can remarkably improve the bone-regenerative ability and promote the in vivo formation of new bone tissues (El-Fiqi et al., 2015; Zhang et al., 2013; Schumacher et al., 2017; Wu and Chang, 2014).

In clinical practice, implant associated bacterial infection, one of the most devastating complications, may occur after orthopedic implant surgery (Huo et al., 2013; Liu et al., 2012). When a bone becomes infected, the soft inner part (bone marrow) often swells, resulting in the death of parts of the bone (Long et al., 2014). Therefore, the development of novel MBGs with enhanced osteogenic activity and antibacterial property is of scientific and clinical significance. Osteomyelitis due to bacterial infection is generally treated by implant removal, systemic antibiotic administration, wound drainage, and surgical debridement (Zhao et al., 2008). However, the above methods need additional surgical interventions and limit their clinical applications. Fortunately, an alternative strategy is to introduce the drug delivery system. After antibiotic drugs including gentamicin and vancomycin in the MBGs, the controlled release of drug molecules from the carriers significantly minimizes bacterial adhesion and prevents biofilm formation against *Staphylococcus aureus* and *Staphylococcus epidermidis* (Liu et al., 2014; Polo et al., 2017; Gholipourmalekabadi et al., 2016; Li et al., 2013; Zhu et al., 2011a).

In this review, we summarize the fabrication strategies of MBG particles, coatings, fibers, and three-dimensional (3D) scaffolds for bone regeneration and repair. MBGs as drug delivery systems provide an especially multifunctional platform for delivering functional ions or drugs/growth factors. The roles of MBGs loaded with drug molecules on bone tissue regeneration and antibacterial application are discussed.

4.2 FABRICATION AND FORMATION MECHANISM OF MBGs

4.2.1 Formation Mechanism of MBGs

Silicate/aluminosilicate mesoporous molecular sieves designated as M41S, one of the important mesoporous materials, were firstly reported by Kresge et al.