the silica fragments in the presence of yttrium, yielding a glass composition with appropriate bioactivity. In the following study, they fixed the glass network connectivity of 2.61 in a range of yttrium bioactive glass to determine the relationship between the structural features with the glass composition. At the same time, Christie et al. explicitly assess the effect of incorporating higher yttria amounts in glasses to enhance the efficacy (Christie and Tilocca, 2012). The results showed the possibility of producing yttrium containing bioactive glass with sufficient biological activity to support growth of new tissues and capable of delivering higher radiation doses through a higher yttria content. The unwanted dissolution of harmful amounts of radioactive yttrium could be restricted by the strong Y-NBO association which leads to increasingly stronger cross-links, preventing a too rapid degradation of the glass network.

10.3.4 Mesoporous Bioactive Glasses for Targeted Tumor Therapy

Besides brachytherapy, an alternative approach to treat a targeted cancer is to introduce a local drug release system into the malignant tumor (Wolinsky et al., 2012). The advantages of this treatment include high delivery efficiency, continuous treatment, reduced toxicity, and convenience to the patients (Zhao et al., 2008; Zhu et al., 2001; Wu and Chang, 2012; Wu et al., 2017). Mesoporous materials have attracted great attention owing to their significant features of a large surface area (600–1000 m^2/g), high pore volume (0.6–1.0 mL/g), and narrow mesoporous structure, which make it possible to adsorb drug molecules and release them from the meso-structured matrices with a sustained profile (Caldorera-Moore et al., 2010). Therefore, it is of great importance to design and develop a new class of mesoporous bioactive glass that combines efficient drug delivery and excellent bioactivity. The concept was first carried out by Vallet-Regi (Vallet-Regi et al., 2001). In 2004, Yan et al. synthesized highly ordered mesoporous BGs by using nonionic block copolymers as structure-directing agents through an evaporation-induced self-assembly (EISA) process with superior bone-forming bioactivity in vitro (Yan et al., 2004). The loading efficiency of drug and growth factors in mesoporous bioactive glass is significantly higher than that in conventional BGs. The drug release kinetics in MBG is lower than that in conventional BGs. Their study has opened a new anticipation that mesoporous BGs with controllable morphologies can be used for drug delivery or coating materials. In the following years, mesoporous BGs with different preparation methods and material forms have been used for the study of drug delivery.

In particular, this section will focus on mesoporous BGs as potential drug delivery systems, especially applied to tumor therapy, since they offer a solid framework with regularly sized pores, in the range of 15–100 Å, which allow encapsulation of a variety of hydrophobic and hydrophilic antineoplastic agents, and a high surface area, capable of hosting targeting groups. These properties endow the mesoporous bioactive glass with the unique advantage of directly delivering therapeutic/diagnostic agents to the desired location.