expression of osteogenic genes (Xynos et al., 2000, 2001), and to stimulate angiogenesis (Leach et al., 2006; Leu and Leach, 2008; Gorustovich et al., 2010).

Bioactive glass has demonstrated appealing characteristics including ease in controlling the chemical composition and, thus, the rate of degradation, making them attractive for a variety of applications. Several groups of glasses, based on silicate, borate, and phosphate glass compositions, have been shown to be bioactive (Hench, 1998; Rahaman et al., 2011; Fu et al., 2011b). Among them, silicate-based glasses are the most widely studied bioactive glass systems. In particular, 45S5 glass, sometimes referred to by its commercial name Bioglass, remains the de facto standard in this material family. Particles of 45S5 glass have been commercialized in several successful medical products including Perioglas (NovaBone Products LLC, Alachua, FL), Novabone (NovaBone Products LLC), and NovaMin (Glaxo-Smith-Kline, UK) (Hench, 2013). Another silicate glass designated 13–93 has received increasing attention due to its better processing characteristics by viscous flow sintering (Brink, 1997; Brink et al., 1997). Borate glasses have a lower chemical durability than silicate-based bioactive glasses, resulting in faster degradation kinetics (Yao et al., 2006; Huang et al., 2006; Fu et al., 2010b). The fast ion release resulting from glass degradation is also found to promote angiogenesis and wound healing (Bi et al., 2012; Zhao et al., 2015). Phosphate glasses have the lowest chemical durability and are soluble in body fluid, which makes them a suitable candidate for restorable materials (Brink et al., 1997). A summary of major bioactive glass compositions is shown in Table 15.1.

In addition to the network formers, modifier oxides such as Na_2O, K_2O, CaO, and MgO are often present to improve bioactivity and the glass processing window. Dopants such as SrO, ZnO, CuO, and CaF_2 are incorporated in certain glasses to introduce specific biological responses through their ionic dissolution products (Hoppe et al., 2011).

15.3 FABRICATION OF BIOACTIVE GLASS SCAFFOLDS

A variety of methods have been used to fabricate bioactive glass scaffolds, including sol-gel, thermal bonding of particles, fibers, or spheres, polymer foam replication, freeze casting, and solid freeform fabrication (SFF). In general, interconnected pores with a mean diameter (or width) of 100 μm or greater, and open porosity of >50% are considered to be the minimum requirements to permit tissue ingrowth and function in porous scaffolds (Hulbert et al., 1970; Hollinger et al., 1996; Karageorgiou and Kaplan, 2005). A brief review of these fabrication techniques is presented to give a general idea of the methodology.

15.3.1 Sol-Gel Processing

The sol-gel process typically involves the foaming of a sol with the aid of a surfactant, followed by condensation and gelation reactions, as described for