

Consequently, the response of porous scaffolds in multiple loading modes—such as compression, flexure, and torsion—and the fatigue resistance of the scaffolds are relevant. Bioactive glass scaffolds are also brittle, so their resistance to fracture, as determined by their fracture toughness, and evaluation of their mechanical reliability using statistical analysis (Weibull statistics) are relevant to brittle materials.

15.4.1 Strength

Data compiled from over 20 studies (Fig. 15.3) show the range of compressive strengths for bioactive glass scaffolds with different compositions and fabricated using a variety of methods. A few trends can be observed. First, the compressive strengths span almost three orders of magnitude, ranging from 0.2 to 150 MPa for porosities of 30%–95%. For the same glass composition and scaffold microstructure (fabrication method), the strength increases with a decrease in porosity, which is also commonly observed for other porous materials. The data show that porous bioactive glass scaffolds can be fabricated with compressive strengths comparable to the values reported for human trabecular and cortical bones (Table 15.2).

Second, the data show that the architecture (or microstructure) of the scaffold, which results from the fabrication method, has a strong effect on the strength, regardless of the composition of the glass. For the same porosity, scaffolds with an oriented pore architecture show a far higher compressive strength

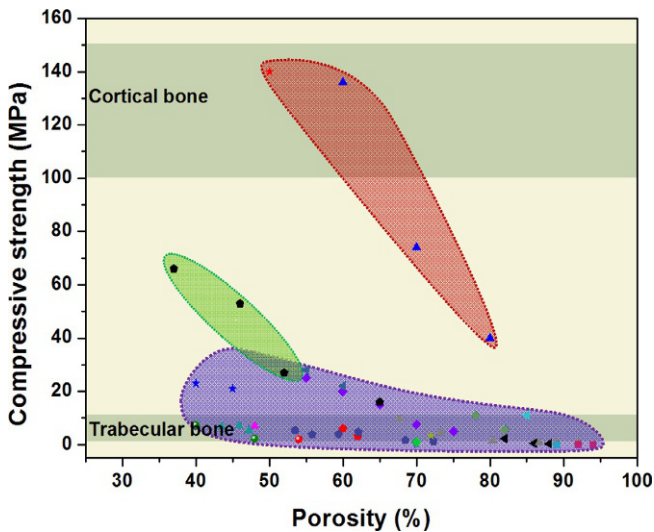


FIG. 15.3 Compressive strength of bioactive glass scaffolds compiled from literature studies, and grouped based on their structures. Purple: isotropic scaffolds; green: anisotropic scaffolds; pink: periodic scaffolds (Fu et al., 2013).