glass fillers, colloidal silica, glass ceramics, aluminum silicate, calcium silicate, lithium aluminum silicate, barium, strontium, zirconium, and so on (Jia, 2001). Filler concentration in organic matrix should be 30%–70% by volume and 50%–85% by weight (McCabe and Walls, 2013). The physical and mechanical properties are upgraded by expanding inorganic filler content up to 70% (German, 2016; Marghalani, 2016).

The main advantages of these ceramics-based fillers are that they are strong, biocompatible, and bioinert; however, it is difficult to fabricate them. These fillers have another limitation that is, they do not have tendency to replace the natural tissues. Therefore, bioceramics have gained importance in dentistry. Mainly, for dental applications, calcium phosphate family and bioactive glass have been used.

17.1.3.1 Amorphous Calcium Phosphate

Aaron S. Posner prepared amorphous calcium phosphate (ACP) [$Ca_9(PO_4)_6$] with molecular weight 310.174 g/mol for the first time in 1960s (Boskey, 1997). Then, it was widely used as a filler in dental cements and resin-based composites and adhesives due to its bioactive nature, biocompatibility, and better cell attachment with oral tissues (Dorozhkin, 2013). Amorphous precipitation of calcium phosphate is a spontaneous reaction that is initiated by mixing of calcium and phosphate, which after sometime, forms crystalline apatite (Li et al., 2007). It is reported that ACP is capable of sustained release of Ca^{2+} and PO_4^- ions over a long period of time that leads to the formation of crystalline hydroxyapatite (HA), which is sometimes desirable (Eanes, 1998). ACP has been combined with other filler particles like glass fibers to enhance the mechanical properties. It is reported that addition of glass-forming agents during synthesis of ACP, forms a more stronger composite for restorations with enhanced properties (Zhao et al., 2011; Skrtic et al., 2004). The main drawback of ACP dental composites is aggregation of ACP particles. Therefore, it has low mechanical strength as compared to silanized glass-reinforced composites (Marovic et al., 2014).

ACP-based dental composites have many clinical uses because it is proven that calcium phosphate is capable of remineralizing caries lesion, as shown in Fig. 17.1 (Kumar et al., 2008; Cochrane et al., 2010). They are used as pit and fissure sealants, orthodontic adhesives, restoration in small caries lesions, and as base under amalgam or composites (Skrtic et al., 2003; Frencken et al., 2012; Agarwal et al., 2014; Melo et al., 2016).

17.1.3.2 Hydroxyapatite

HA has a hexagonal structure with Ca/P molar proportion of 1.67 and atomic weight 100.4 g/mol. The apatite structure permits the substitution of different particles bringing change in properties without changing the hexagonal geometry (Vallet-Regi and González-Calbet, 2004). With the appearance