39.2 MATERIAL TYPES AND FABRICATION TECHNIQUES IN MN MANUFACTURING

Over the last two decades, a wide range of materials and techniques have been employed for the manufacture of MNs. Starting with silicon in the late 1990s [5], the focus has since moved to other materials such as metals, ceramics, glass, carbohydrates, and polymers. The possibilities of designing MNs with many different geometries and properties to specifically modify transdermal release profiles of therapeutic agents has increased considerably with newly emerging fabrication techniques.

39.2.1 Silicon

The first fabricated MNs, reported in the late 1990s, were produced from silicon due to the recent developments in microfabrication technologies (i.e., microelectromechanical systems [MEMS]) [5]. The main advantage of silicon is its ability to be fabricated in a wide range of geometries using monocrystalline or polycrystalline silicon. Thus, it has been used to produce solid, hollow, and coated MNs that can successfully pierce the skin, facilitating transdermal drug delivery [9]. Existing manufacturing techniques are precise and can be easily scaled up [20], an attractive prospect for potential investors in the technology. However, high costs, the complex multistep manufacturing, and therefore long fabrication times are major drawbacks [20]. Additionally, concerns over the biocompatibility of silicon have been raised. After skin insertion, silicon fractures could remain in the skin, as it is a brittle material. Some pieces can be naturally discarded, but silicon-related granulomas have been reported in the past [21]. MEMS technology involves three basic sequential techniques. Briefly, the first fabrication step involves the coating of the substrate (in this case silicon)

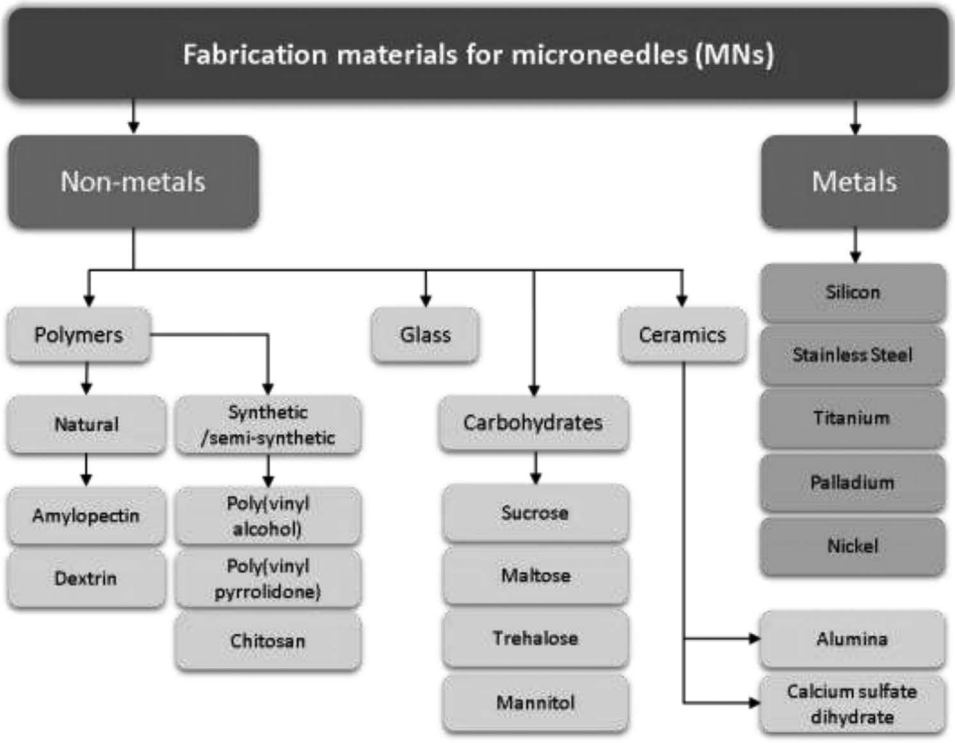

FIGURE 39.3 Materials used for the preparation of MNs.