**ABSTRACT**

Polymer-based nanofibril finds its application in various fields including tissue engineering, environmental monitoring, food packaging, and micro/nanoelectromechanical systems. These nanofibrils are subjected to chemical treatment and constant stress, which may cause permanent deformation to the fibrils when it is used. Therefore, the synthesis of well-defined nanofibrils and characterization techniques are key elements in identifying desired chemical and physical properties for suitable applications. Many methods have been developed to prepare individual nanofibrils, including electrospinning, phase separation, template synthesis, and self-assembly. Among all, self-assembly offers simple, efficient, and low- cost strategies that produce high-ordered nanofibrils using noncovalent interactions including hydrogen bonding, electrostatic interactions, π-π interactions, and hydrophobic interactions. The first part of the review provides detailed molecular interactions and simulations that can be controlled to achieve the for-mation of well-defined individual nanofibrils. The second part of the review describes the various existing tools to characterize the chemical and physical properties of single nanofibrils including atomic force microscopy. In the final part of the review, recently developed novel nanotools that measure the mechanical properties of nanofibrils are described. By bridging the gap between molecular interactions and resulting nanoscale fibirls, physical and chemical properties may lead to the construction of novel nanomaterials in the area of nanoscience and nanotechnology.