Self-Assembling Polymer-DNA Hybrids

Dawid Kedracki and Corinne Vebert-Nardin

Department of Inorganic and Analytical Chemistry, University of Geneva-Sciences II;
30,quai Ernest-Ansermet, CH-1211 Geneva 4,
Switzerland.

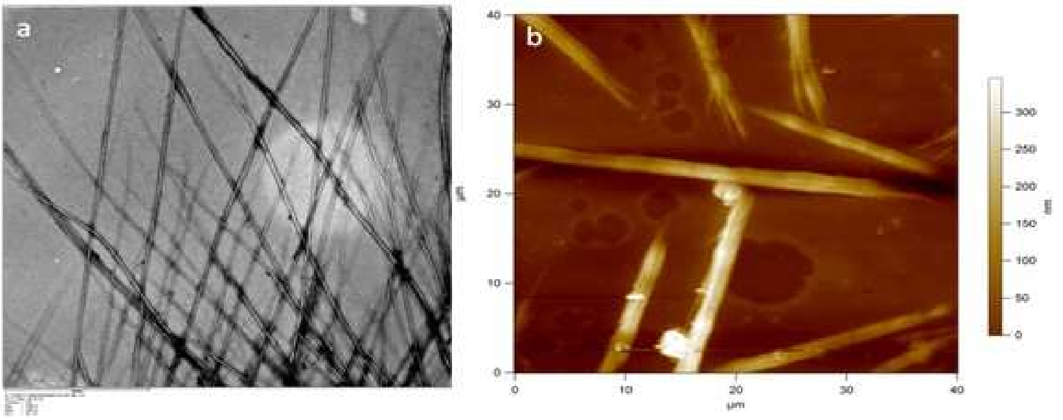

Figure 1. a) TEM b) AFM images displaying fibrilar structures resulting from the self-assembly of the polymer-nucleotide hybrid

Soft materials based on self-assembling copolymers hold great promises for applications in the biomedical industry as well as for the development of future technologies based on the design of advanced functional materials resulting from their hierarchical organization at several length scales. Self-assembling copolymers indeed assemble into sophisticated functional structures through non-covalent, highly specific interactions like it occurs in Nature, which gives the greatest examples of the importance of such structures, like those found in the human body such as bone or tooth. Being composed of both synthetic and biological units, bio-hybrids belong to a special class of such self-assembling copolymers. A particularly interesting class are molecular chimeras in which the biological component is a single stranded DNA fragment. Owing to its involvement in a countless number of vital biological mechanisms and its inherent properties, like ability to transfer the universal genetic information, the conjugation of DNA with biocompatible polymers has thus recently become a topic of intense research. Conjugation is for instance expected to overcome issues such as limited plasma half-life as well as cellular penetrability. Conjugation with synthetic polymers which are not water soluble result in self-assembled structures revealing the remarkable properties of the constitutive DNA fragment. Herein, we therefore report on the conjugation of the hydrophobic thermo-responsive pseudo-peptide POxa polymer with a nucleotide sequence which self-assembles in water to give rise to tubular structures. These structures were characterized by various techniques i.e., fluorescence microscopy, atomic force microscopy (AFM), scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The design of this fully biocompatible self-assembling material paves the way for a plethora of potential applications such as mineralized tissue regeneration, gene therapy as well as molecular DNA probing.