SELF-ASSEMBLED POLYPEPTIDE SURFACTANT BASED AEROSOL NANO-PARTICLES FOR CONTROLLED DRUG DELIVERY

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Poly-l-lysine (PLL, $M_w = 23000$ g/mol) homopolypeptide was complexed stoichiometrically with dodecylbenzenesulfonic acid (DBS) to form a grafted PLL-DBS copolymer. In bulk, this complex self-assembles to hexagonal cylindrical structure when PLL has adopted $\alpha$-helical conformation. Thermal treatment at ~120 °C leads to formation of lamellar domains where PLL has adopted $\beta$-sheet conformation.

Nanoparticles of PLL-DBS were prepared by the aerosol flow reactor method [2]. For drug release experiments, PLL-DBS formulations containing ketoprofen, budesonide, or 1,8-ANS fluorescence probes were also prepared. The complexes, with the additional drug or fluorescent molecules, were dissolved in an organic solvent. The solution was then atomized into nanodroplets, which converted into solid aerosol nanoparticles in a heated reactor. The structure of the self-assembled PLL-DBS nanoparticles were analyzed by TEM revealing a few lamellar layers on the surface with wormlike cylinders in the core at room temperature with increasing lamellar content as the reactor temperature was incremented from 20 °C up to 240 °C. FTIR analysis on the nanoparticles indicated that PLL conformation depended on the solvent used. With 1-propanol PLL adopted $\beta$-sheet conformation at each temperature, while using CHCl$_3$ or DMF the conversion from $\alpha$-helix to $\beta$-sheet took place at 100 °C and 240 °C, respectively.

Figure 1. PLL-DBS nanoparticles prepared from DMF as a solvent with 240 °C annealing temperature showing a) lamellar structure in a TEM micrograph and b) nanoparticle clusters in a SEM micrograph.