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Biodegradable Self-Supporting Nanofiber Membranes Prepared by Centrifugal Spinning

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Abstract : While most nanofibers are produced using electrospinning, this technique suffers from several drawbacks, such as the requirement for specialized equipment, high electrical potential, and electrically conductive targets. Consequently, recent years have seen the increasing emergence of novel strategies in generating nanofibers in a larger scale and higher throughput manner. The centrifugal spinning is simple, cheap and highly productive technology for nanofiber production. In principle, the drawing of solution filament into nanofibers using centrifugal spinning is achieved through the controlled manipulation of centrifugal force, viscoelasticity, and mass transfer characteristics of the spinning solutions. Engineering efforts of researches of the Food research institute Prague and the Czech Technical University in the field the centrifugal nozzleless spinning led to introduction of a pilot plant demonstrator NANOCENT. The main advantages of the demonstrator are lower investment cost - thanks to simpler construction compared to widely used electrospinning equipments, higher production speed, new application possibilities and easy maintenance. The centrifugal nozzleless spinning is especially suitable to produce submicron fibers from polymeric solutions in highly volatile solvents, such as chloroform, DCM, THF, or acetone. To date, submicron fibers have been prepared from PS, PUR and biodegradable polyesters, such as PHB, PLA, PCL, or PBS. The products are in form of 3D structures or nanofiber membranes. Unique self-supporting nanofiber membranes were prepared from the biodegradable polyesters in different mixtures. The nanofiber membranes have been tested for different applications. Filtration efficiencies for water solutions and aerosols in air were evaluated. Different active inserts were added to the solutions before the spinning process, such as inorganic nanoparticles, organic precursors of metal oxides, antimicrobial and wound healing compounds or photocatalytic phthalocyanines. Sintering can be subsequently carried out to remove the polymeric material and transfer the organic precursors to metal oxides, such as Si02, or photocatalytic Zn02 and Ti02, to obtain inorganic nanofibers. Electrospinning is more suitable technology to produce membranes for the filtration applications than the centrifugal nozzleless spinning, because of the formation of more homogenous nanofiber layers and fibers with smaller diameters. The self-supporting nanofiber membranes prepared from the biodegradable polyesters are especially suitable for medical applications, such as wound or burn healing dressings or tissue engineering scaffolds. This work was supported by the research grants TH03020466 of the Technology Agency of the Czech Republic.

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