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(ICE-P052-2014) Nanoparticle dispersion in PEO polymeric solutions via plasma treatment for the production of electrospun lithium batteries separator

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The use of electrospun mats is considered an innovative solution for the production of separators for lithium-ion batteries. Furthermore, the addition of oxide nanoparticles is known to be a suitable way to increase mechanical, thermal and electrical properties of the electrospun separators. Conventional techniques such as mechanical stirring, sonication, ball-milling and sol-gel methods have been investigated in the past in order to improve nanoparticle dispersion. This work is focused on a novel treatment, where an atmospheric pressure plasma is employed to treat the polymeric solution thus facilitating nanoparticle dispersion. Poly(ethylene oxide) (PEO) is dissolved in bidistilled water and fumed silica nanoparticles (average size = 7 nm) are added to the solution. The electrospinning solution, either before or after nanoparticle addition, is exposed to a plasma jet driven by high voltage nanosecond pulses. In addition, mechanical stirring is performed both on treated and reference samples. A very good particle dispersion in the electrospun fibers of plasma treated polymeric solutions is observed by means of transmission electron microscope. In particular, when a 3 minutes plasma treatment of the solution is followed by 10 minutes stirring of nanoparticles, an outstanding dispersion of fumed silica is obtained in the produced nanofibers.

(ICE-P053-2014) Atmospheric pressure plasma enhanced electrospinnability of poly (L-lactic acid) solutions

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The influence of atmospheric pressure non-equilibrium plasma treatment on the electrospinnability of poly(L-lactic acid) (PLLA) solutions is investigated. PLLA is a biocompatible and biodegradable polymer and can be processed into nanofibers by electrospinning, dissolving it in dichloromethane (DCM) and dimethylformamide (DMF). The latter is added to DCM to increase the dielectric constant of the solution, thus ensuring its electrospinnability. The boiling temperature of DMF is around 153°C, higher than that of DCM (40°C): it is therefore difficult to completely avoid traces of residual DMF in the electrospun nanofibers. The production of scaffolds for biomedical applications without any trace of residual organic solvents would be a great chance in order to increase material biocompatibility. In this work we treat a solution of PLLA in plain DCM by using an atmospheric pressure non-equilibrium plasma jet, in order to improve its electrospinnability in the absence of DMF. The plasma jet is driven by several different high voltage waveforms: sinusoidal, triangular and square waveforms with nanosecond or microsecond rise times are here employed. Considerations on the effects of voltage waveform, peak voltage, frequency and treatment time will be presented. In particular, the beneficial effect of using nanosecond high voltage pulses will be highlighted.

(ICE-P054-2014) Enlarging Pore Size for Improving Cell Infiltration in Electrospun Scaffolds by Positive Voltage and Negative Voltage Electrospinning

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Small pore size, which limits cell infiltration, is a major problem for electrospun tissue engineering scaffolds, hampering their progress towards clinical applications. Most of current methods for enlarging pore size in electrospun scaffolds affect the nanofibrous structure or scaffold mechanical properties. This study investigated a new approach for enlarging pore size without causing aforementioned problems. The dual-source dual power electrospinning technique was employed to fabricate intermeshed nanofibrous membranes, and power supplies of negative voltage (NV) and positive voltage (PV) were used to produce polymer fibers with different electrical charges (polarity and magnitude). Scaffolds composed of PLGA fibers were electrospun using different polarity combinations (NV+NV, PV+PV, PV+NV) and different applied voltages (±10, ±15 and ±20 KV). The electrical charge of resultant scaffolds was measured using an electrostatic voltmeter. It was found that PLGA scaffolds made by high voltages (either PV or NV) would bear corresponding charges which were retained at about 30% of its initial charge value after one week. The porous structure was different for scaffolds made in different conditions. Scaffold made by PV+NV showed enlarged average pore size. Cell culture experiments are now conducted to assess cell infiltration in different scaffolds.

(ICE-P056-2014) Development of pulse electrospinning installation and getting micron length of polymer fibers

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The aim of this work is the development and construction of the pulse electrospinning to produce nano-sized particles, with the ability to control their size. The prefix “ nano” means that the dimensions of the particles to range from 10 to 500 nm in at least one dimension. The prototype of the pulse electrospinning setup is a classic electrospinning setup, which operates at a constant voltage. In the pulse electrospinning setup unlike classical setup high voltage is applied in the form of controlled pulses, which allows to obtain a controlled fiber length. We have designed and developed a pulse electrospinning setup, which has a higher amplitude of the high voltage - 16 kV (which is 6 kV more than the above settings). In the present apparatus for producing a pulsed high-voltage high-frequency transformer is used. A schematic diagram and photo of pulse electrospinning setup is showed. The experimental results suggest following conclusions: It was designed and created a newest installation of pulsed electrospinning to obtain short fibers; Short fibers was obtained experimentally . For example, short fibers with diameter of 500 nm and a length of 5 microns was obtained from cellulose acetate and ABS polymer.

(ICE-P057-2014) Surface modification of electrospun poly (Acrylonitrile-co- Styrene) copolymer nanofibers towards developing a dye removal

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Electrospun nanofibers with a high surface area to volume ratio have received much attention because of their potential applications for heavy metal and dyes removal. In this study, firstly, poly (Acrylonitrile-co- Styrene) (poly (AN-co-ST)) copolymer nanofibers with an average diameter form 80 nm to 1 μm were synthesized by solution polymerization of Acrylonitrile (AN) monomer and ST monomer crosslinker in the presence of Potassium persulfate ($K_2S_2O_8$) initiator. Secondly, electrospinning of poly (AN-co-ST) copolymer in dimethyl formide (DMF) solvent have been investigated. Poly (AN-co-ST) nanofiber was modified and functionalized through introducing terminal carboxylic acid groups on the surface. The modified nanofiber was followed by Attenuated Total Reflectance Fourier Transformed Infrared (FTIR) measurements. The surface morphology and thermal behavior of the poly (AN-co-ST) nanofiber and their modified form were also characterized by scanning electron microscopy (SEM) and thermogravimetric analysis (TGA) techniques further confirming modification.