Supporting Information

Electric Field Induced Orientation of Polymer Chains in
Macroscopically Aligned Electrospun Polymer Nanofibers

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Material

Poly(ethylene oxide) \([-\text{CH}_2-\text{CH}_2-\text{O}-\]_n\) (PEO) was chosen because it is water soluble
and can be easily electrospun from aqueous solutions. PEO has been widely studied in
electrospinning\(^1\) and thoroughly characterized structurally\(^2\)-\(^5\). It is semi-crystalline,
exhibits good mechanical properties and, since it is a biocompatible\(^6\) thermoplastic,
electrospun PEO nanofibers have found a variety of applications in biomedical\(^7\)
research.
**Procedures**

Two different PEO mats of namely uniaxially aligned nanofibers and isotropically aligned nanofibers were fabricated via electrospinning. The electrospinning set-up and all the parameters used were maintained the same for both the mats except for the way in which the fibers were collected. For electrospinning, 8 wt% (w/w) solution of PEO, (Sigma Aldrich, molecular weight 300,000) in water was prepared at room temperature using a magnetic stirrer. The electrospinning of PEO solution was carried out using a 5mL syringe (Popper and sons, Inc) with a 91026 gauge needle (Hamilton). To fabricate uniaxially aligned fibers, a set of charged conductive flat plates (typically - two aluminum tensile testing samples 13cm x 3cm x 0.4cm joined together with an insulating tape) with a 1.2 cm gap between them was used as a collector. This gap could be altered from a few millimeters to a few centimeters. The needle was held at +8 kV and the collector plates at -6 kV. Grounded aluminum foil was placed below the plates. The flow rate was maintained at 1 mL/hr using a syringe pump (Sage Instruments). The vertical working distance was held at 12 cm and the temperature was maintained at 22°C with 34% relative humidity. All the samples were collected after 30 minutes of electrospinning. The bulk of the sample would increase by electrospinning for longer durations. A grounded aluminum foil (without the counter-electrode flat plates) was used as a collector to collect the isotropic fibrous mat, with all other electrospinning parameters and the set-up remaining the same. For visualization of the resulting collection of fibers, an optical microscope with 20x magnification was utilized. A
JEOL JSM 7400F field emission scanning electron microscope (FE-SEM) was used with a low energy ionization detector. The emission was 10mA and the accelerating voltage was 5kV. Prior to FE-SEM studies, the samples were sputtered with gold for 45 seconds. The infrared measurements were carried out using a Thermo Nicolet – Nexus 670 FT-IR with a ZnSe polarizer. The spectra were recorded at 4 cm-1 resolution using the co-addition of 400 scans. For Raman studies, a Spectra Physics 3900 Ti/sapphire laser operating at 785 nm was used in conjunction with a Kaiser HoloSpec spectrograph equipped with a Princeton Instruments CCD detector. Thirty accumulations using a 60 sec acquisition time were processed using the Winspec-32 software. For the polarized FT-IR and polarized Raman measurements, the samples were held stationary while only the incident and scattered polarizations were rotated to ensure the measurement was done on the same spot and at the same level of the sample. This was done in order to avoid any discrepancy of data due to differences in sample thickness at different areas. X-ray diffraction studies were carried out on the aligned nanofiber bundles using a rotating anode X-ray generator (Ni filtered Cu-Kα radiation) with MAR image plate detector.
References


