

# STUDY OF WELL ALIGNED CONTINUOUS ELECTROSPUN NANOFIBERS OF POLY (AMIDE-COIMIDE)/POLY (TRIMELLITIC ANHYDRIDE CHLORIDE-CO-4, 4'-METHYLENEDIANILINE) USING SOLVENT MIXTURE OF DMSO/THF

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## 1. Introduction

Poly(amide-co-imide) PAI thermoplastics have been the material of choice for the fabrication of large load bearing composites due to their high strength, superior stiffness, excellent thermal resistance and high performance[1-2]. PAI has been extensively used in filtration media, wire enamels and for reinforcement by virtue of its superior chemical resistance and physical properties at higher temperature[3-4]. In our previous study we produced nanofibers of Poly (amide-co-imide) (PAI) which has been newly synthesized by Korea research institute of chemical technology (KRICT) and then post-processed by glycerol coating and thermal imidization at high temperature under tension to separate individual nanofibers within fiber bundles. The improvement of the mechanical properties of the PAI nanofibers was studied by rotating repulsive and rotating collector electrospinning systems [5]. In this study Nanofibers of Poly (amide-co-imide) PAI (torlon)/Poly (trimellitic anhydride chloride-co-4, 4'-methylene dianiline) (PTACM) blends have been tried to prepared by using mechano-electrospinning. The properties of these blends were investigated using a rotational rheometer (AR 2000), SEM, DSC, and TGA in an attempt to understand the relationships between their rheological, morphological, and thermal properties. However by utilization of mixed solvent systems of DMSO and

THF, we could obtain continuous fibers with improved mechanical properties. The continuity of the fibers was strongly dependent on the solvent mixing ratio of DMSO and THF (6:4). Nano continuous fibers with the most uniform diameter were obtained when a 30 % weight ratio of PAI and PTACM (1:1) resins was used in the blending solution.

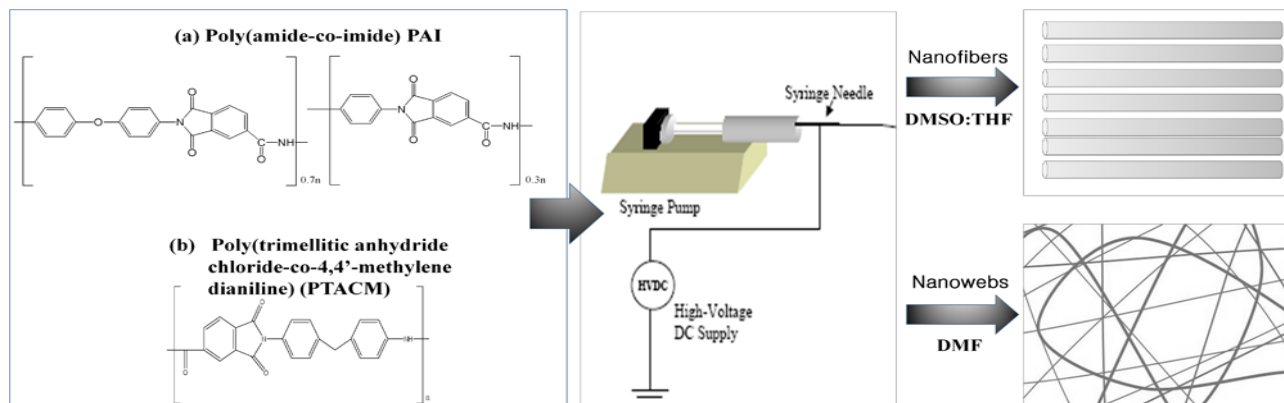
## 2. Experiment

### 2.1. Materials

PAI resin (Torlon® 4000T-HV, Solvay Advanced Polymers, USA) and poly (trimellitic anhydride chloride - co - 4, 4'- methylenedianiline) (PTACM) Sigma Aldrich, USA) were used to prepare the spinning dopes in this study..All solvents DMF, DMSO and THF are of analytical grade and purchased from Sigma Aldrich.

### 2.2. Preparation of continuous and aligned nanofibers

Continuous nanofibers were prepared using 30 % weight ratio of PAI and PTACM (1:1) resins in the blending solution of 6:4 (DMSO: THF) as shown in Scheme 1.The obtained fiber is highly aligned in the water bath under mechanical tension applied by the high speed winding roller. It was vacuum dried at 190°C for 1hr to completely remove the solvents. Vacuum dried electrospun nanofibers were again



Scheme 1: Effects of solvent systems on the determination of fiber formation with PAI and PTACM resins.

subjected for imidization at the different temperature 300,320,330 and 340 °C.

### 3. Results and Discussion

The PAI/PTACM dissolved by DMF produces only nanowebs. However PAI/PTACM dissolved in mixed solvent system of DMSO: THF (6:4) produces well aligned and continuous nanofibers. SEM images of these systems are shown in Fig. 1.

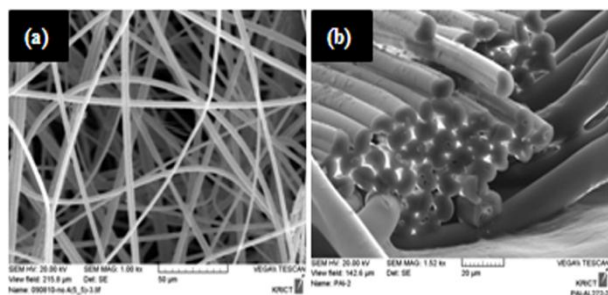


Fig.1: Effects of different solvent system on the morphological properties of blended nanofiber composed of the same weight fraction and weight ratio (PAI: PTACM 50:50) 30 %; (a) DMF (10:0), (b) DMSO: THF (6:4).

### 4. Conclusion

The optimal conditions to get the continuous fibers were investigated by controlling solvent composition, concentration, voltage, throughput and tip to collector distance. It was observed that continuous fibers can be electrospun only using mixed solvent system. The continuity of the fibers is highly dependent on the formation of stable drop at the end of capillary tip which is influenced by the viscosity and the surface tension of polymer blend and the solvent. In our case we observed that 30 wt % of the polymer blend and mixed solvent ratio of 6:4 yielded continuous fibers.

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