

MATERIALS SCIENCE AND TECHNOLOGY

Consorzio INSTM - Development of polyamide 6 (PA6) nanofibers by electrospinning for radiative cooling textiles

Funded By	CONSORZIO INSTM [Piva/CF:04423980483]
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Context of the research activity	This PhD is part of a large research project entitled: INNOVATIVE POLYAMIDE 6 FIBERS THROUGH NOVEL CHEMISTRIES AND PROCESSES FOR SPECIAL APPLICATIONS AND FOR RECYCLABLE COMPOSITES WITH HIGH PERFORMANCES (INFI-PA6-RECO). Supported by Fondo Italiano per le Scienze Applicate FISA 2024, the INFI-PA6-RECO project concerns innovative synthesis, processing and application of PA6, with a full commitment to sustainability by enhancing the durability of the products and their full recyclability.
Objectives	This PhD project concerns polyamide 6 (PA6) obtained through the hydrolytic or anionic polymerization of ε-caprolactam (CL) with the aim of exploring the fabrication of nanofibers by electrospinning. The process is recognised as a highly versatile technique to prepare fibers with nanometric diameters and solution electrospinning of PA6 is already documented in the literature, while electrospun nanofiber materials are rapidly moving to commercialization. A potential application of nanofibrous polymers is passive radiative cooling as thanks to their nanostructure they minimise IR reflection radiating heat to the environment without any energy consumption. This alternative cooling strategy is applied in personal thermal management. In using PA6 as a polymer, lowering its vibrational intensity requires to regulate the size of the fibers to the nanoscale and to control of PA6 crystallinity by high drawing of the polymer (see doi.org/10.1038/s41467-025-57366-9). Working in tight collaboration with Aquafil SpA, a world leader in PA6 production, based in Arco (TN), along the three years, the main tasks of the PhD candidate are the following: - Study of the solution electrospinning of PA6 produced by Aquafil SpA and optimisation of the process with the aid of statistical modelling tools, screening process parameters/ polymer structure/ final properties of the electrospun polymer - Production of nanofibrous materials - Characterisation of the new textiles as radiative cooling devices - Assessment of the recyclability of the prototype product through chemical

methods developed by Aquafil S.p.A

**Skills and
competencies
for the
development of
the activity**

Candidates should have a deep knowledge of polymer science, in particular they should know the main synthetic routes for the preparation of polymers, the most relevant characterisation techniques and the most common polymer processings. Ability to conduct spectroscopic analyses (in particular FTIR), thermal characterisation (i.e. DSC) and mechanical tests of polymeric materials is required; candidates with previous experience in electrospinning will be preferred.