The SPINNERET project: Electrospun Nanocomposites for Energy Storage

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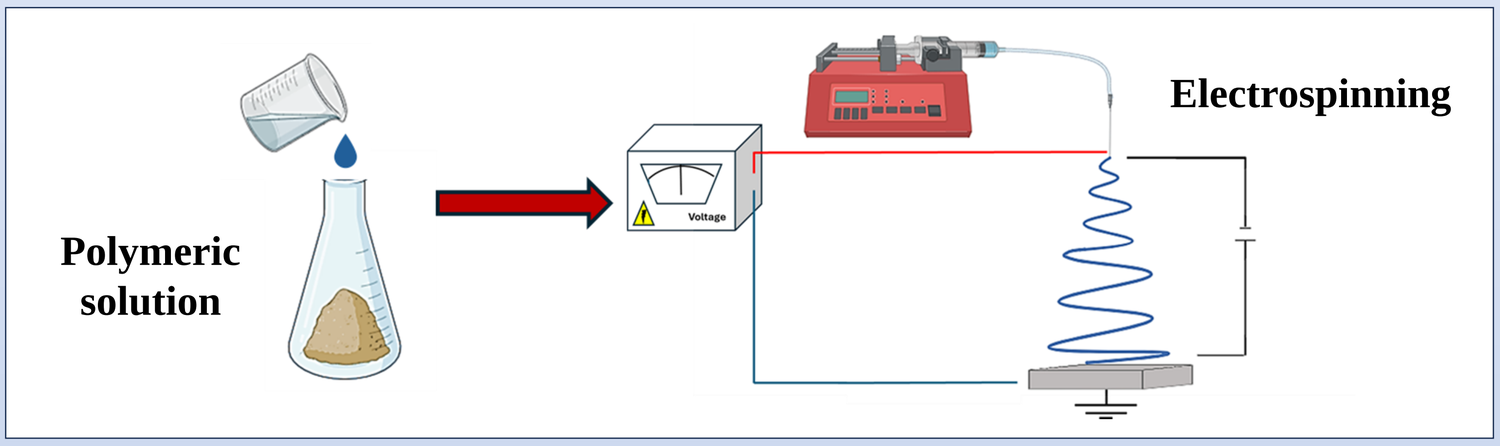
Introduction

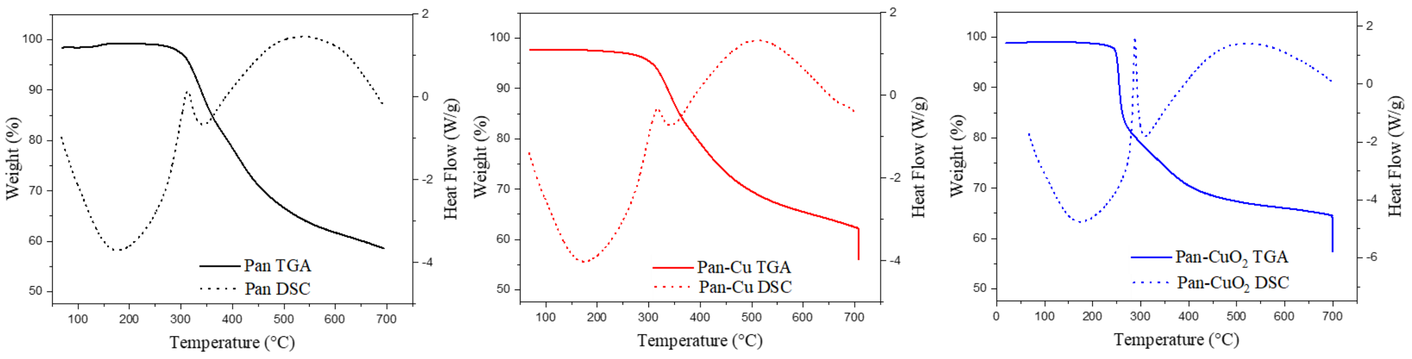
Innovation in the energy storage sector is crucial for the transition towards sustainable technologies, as also highlighted by The European Green Deal which focuses on three key principles for the clean energy transition, to help reduce greenhouse gas emissions and enhance the quality of life. The energy density, cycle stability and safety of lithium-ion batteries still need to be improved for a very large-scale application. Electrodes are key components of batteries and the subject of much research and tremendous effort for developing cells showing high electrochemical performance. The use of nanocomposites based on Cu_2O/Carbon offers unique properties that can address electrode issues. In fact, this material promises higher storage capacity due to increased active surface area and improved electrical conductivity, reducing at the same time the environmental impact of battery production. The SPINNERET project centers on the production of composites nanofibers and aligns with this perspective, aiming to improve and enhance electrode fabrication for the battery industry by increasing the Technology Readiness Level (TRL) of the patent "Electrospun Nanocomposite Materials based on Cu_2O/Carbon as Anodes for Lithium Batteries." The project's goal is to achieve an advancement on a semi-industrial scale, maintaining the high value of the patent and improving the electrochemical performance of the materials. This study presents the optimization of electrospinning parameters on a laboratory scale, with small system improvements that increase reproducibility and ease of replication. Furthermore, an in-depth chemical-physical characterization is conducted, including the preparation of self-standing electrodes, to optimize the best morphology and performance of the resulting material.



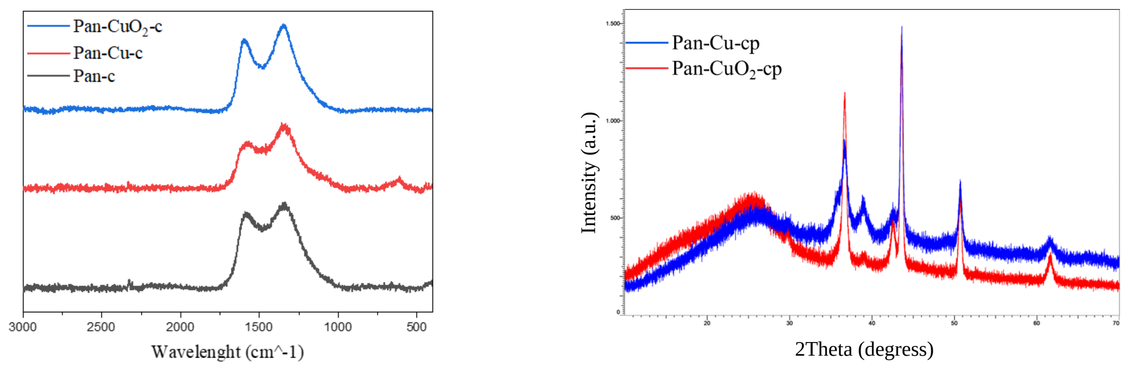
Formula	Solvent	Polymer	Precursor
A	DMF	Pan	-
B	DMF	Pan	Cu
C	DMF	Pan	Cu_2O

Formula	Voltage kV	Flow mL/h	Distance (cm)	T (°C)	RH%
A	14-17	0,8	20	28-30	30
B	14-17	0,8	20	28-30	30
C	14-17	0,8	20	28-30	30

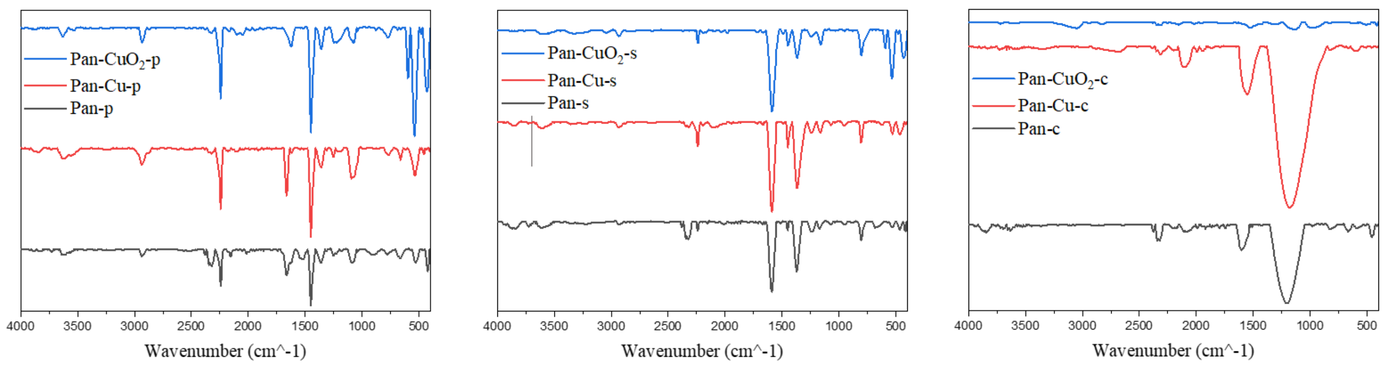
Thermal analysis



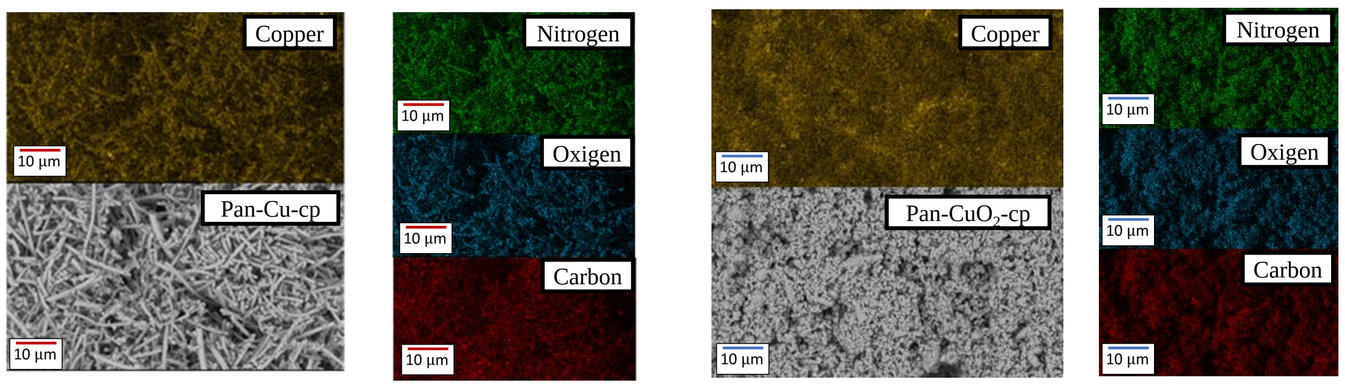
Raman spectroscopy and X-Ray diffraction analysis



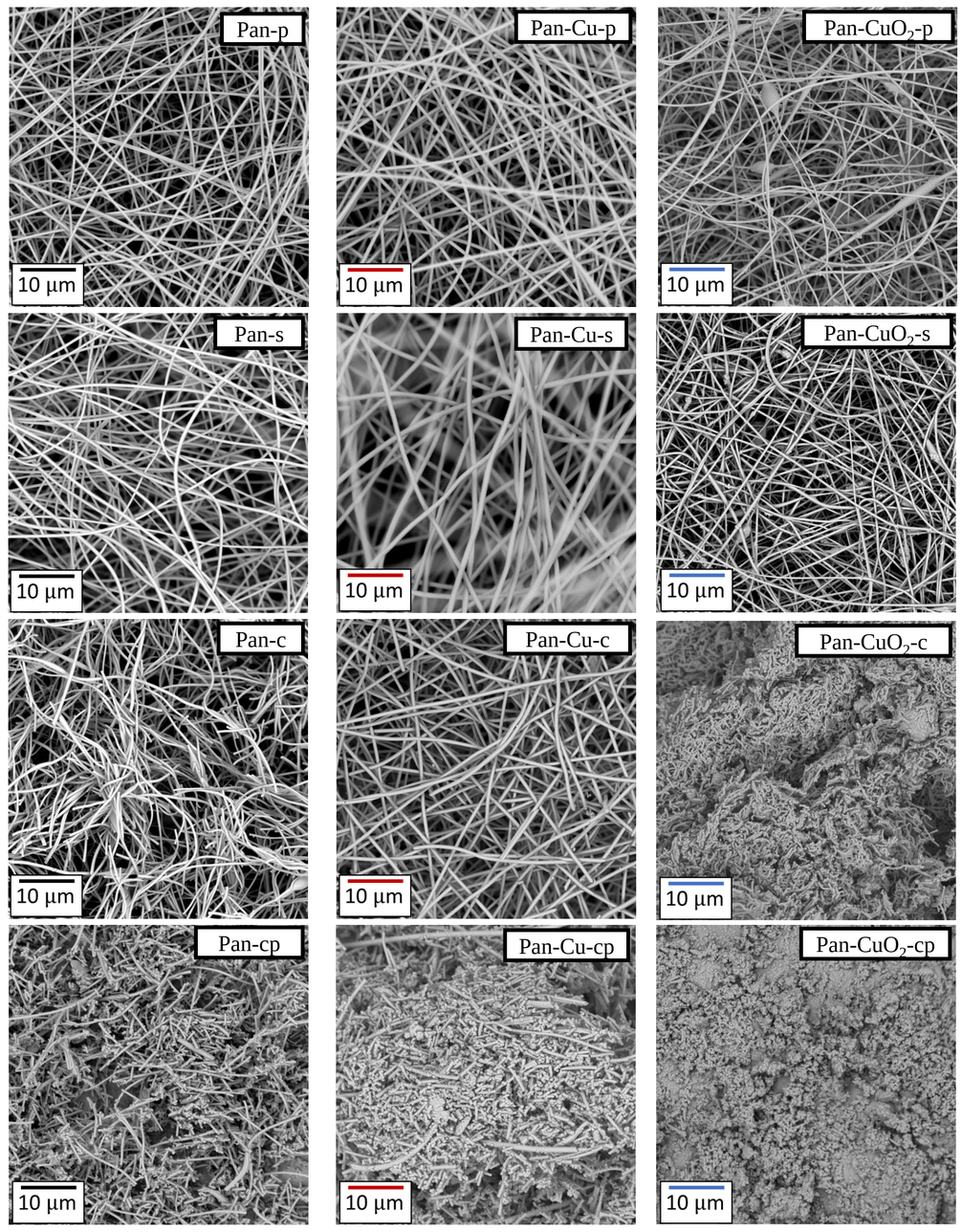
Molecular spectroscopy analysis



Energy dispersive X-ray analysis



Scanning Electron Microscopy analysis



Legenda

	A	B	C
Pristine	Pan-p	Pan-Cu-p	Pan-CuO_2-p
Stabilized (air)	Pan-s	Pan-Cu-s	Pan-CuO_2-s
Calcined (N_2)	Pan-c	Pan-Cu-c	Pan-CuO_2-c
Ground carbon	Pan-cp	Pan-Cu-cp	Pan-CuO_2-cp

References:

1. Patent number 102018000010452, Materiali nanocompositi elettrofilati a base Cu2O/Carbone come anodi per batterie al Litio.
2. *"UdAProVAL" POC 2022 – PNRR Missione 1 Componente 2 Investimento 6, Sviluppo di un PrototIpo elettrofilato a base Cu2O/carbone come anodo di Nuova generazioNe pER battErie al liTio -SPINNERET.*
3. *Electrospun Carbon/Cu_xO Nanocomposite material as Sustainable and High Performance Anode for Lithium-Ion Batteries, Fausto Croce et al.*, doi: 10.1002/open.201900174.