ASEC 2024 Conference

The 5th International Electronic Conference on Applied Sciences

04–06 December 2024 | Online

MDPI

Electrospinning poly(acrylonitrile) (PAN) nanofiber mats with mushroom mycelium powder

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Introduction & Aim

- Electrospinning can be used to produce nanofiber mats for diverse applications
- The large surface-to-volume ratio of nanofibrous membranes is often advantageous
- The spinning process enables integrating of metallic or ceramic nanoparticles, blending different polymers etc.
- Especially for biomedical applications, adding an antibacterial agent can be supportive

→ Here, we report needleless electrospinning of nanofiber mats from poly(acrylonitrile) (PAN) with different mushroom mycelium powders with antibacterial and other positive properties [1,2]

Materials and Methods

Investigated mushroom mycelium:

- *Pleurotus ostreatus* (oyster mushroom) powder (Somatem GmbH, Nidda, Germany)
- *Ganoderma lucidum* (reishi mushroom) powder (GoApollo GmbH, Vienna, Austria)

Electrospinning solution:

- 8 g PAN (X-PAN copolymer, Dralon, Dormagen, Germany)
- 42 g DMSO (min. 99.9%, S3 chemicals, Bad Oeynhausen, Germany)
- 1.35 g mushroom powder

Electrospinning:

- Nanospider Lab (Elmarco Ltd., Liberec, Czech Republic)
- Voltage 60-70 kV, current 0.04-0.06 mA
- Carriage speed 100 mm/s
- Distance electrode-substrate: 240 mm / 200 mm for samples S1/S2 (*P. ostreatus*) and R1/R2 (*G. lucidum*)
- Nozzle 0.9 mm
- Temperature 23-24 °C, relative humidity 32%
- Duration 1 h

Characterization:

- Confocal laser scanning microscopy (CLSM, VK-8710, Keyence, Neu-Isenburg, Germany)
- Scanning electron microscope (SEM) (Phenom ProX G3 Desktop SEM, Thermo Fisher Scientific, Waltham, MA, USA)
- Raman microscopy (WITec alpha300 apyron, Ulm, Germany)

First observations during electrospinning:

- While PAN with *Pleurotus ostreatus* powder could well be electrospun with the wire-based technique, PAN with *Ganoderma lucidum* powder was nearly impossible to spin, with only one of four tests showing thin membranes containing fibrous as well as non-fibrous areas

Further treatment: stabilization and carbonization (500 °C)

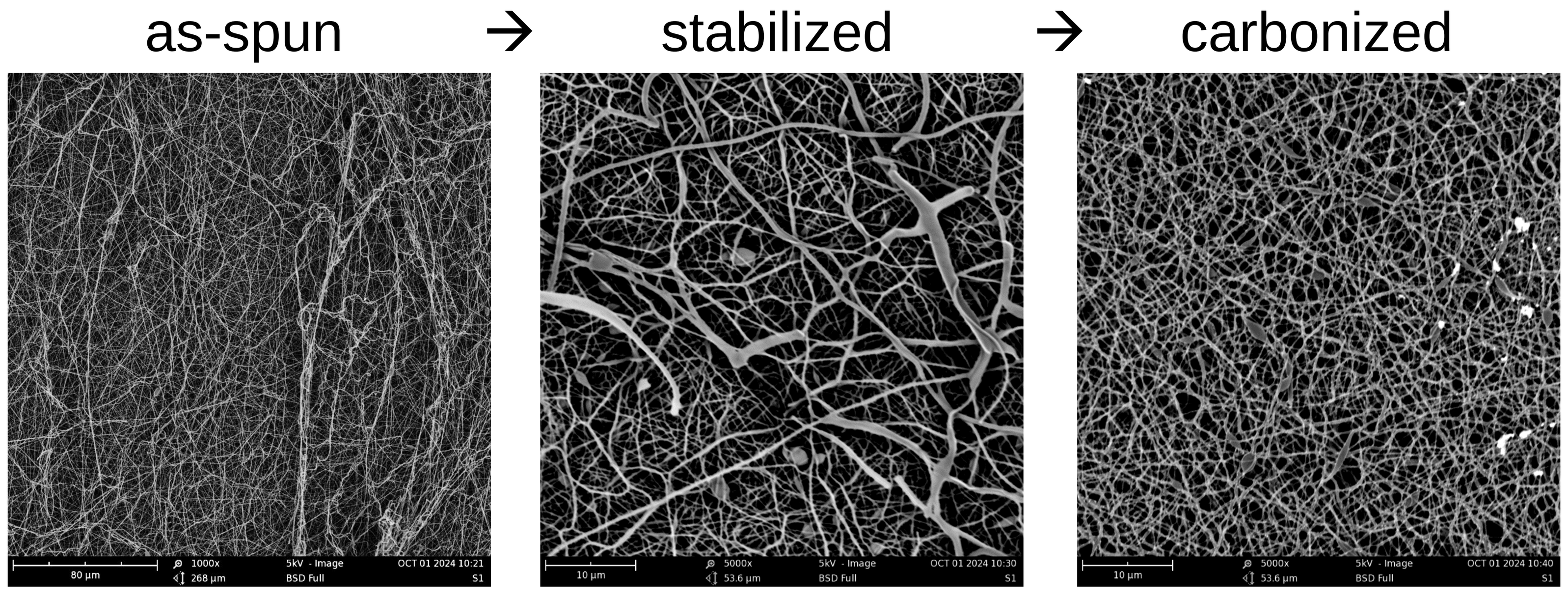
Results

Characterization of *P. ostreatus* nanofiber mats:

- Areal weight: 7.2 g/m² (S1) / 6.2 g/m² (S2)
- Carbon yield: 39% (S1) / 37% (S2)

SEM images (5000 x magnification):

as-spun → stabilized → carbonized

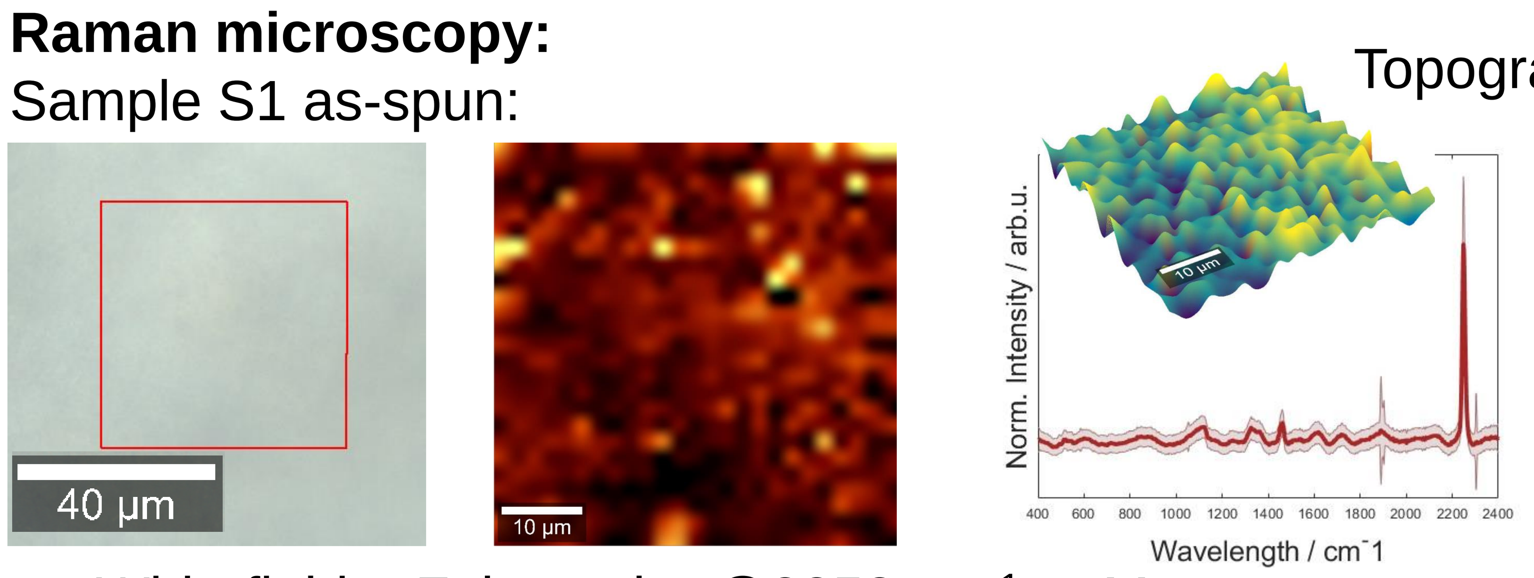


→ Structural changes during carbonization process upon pyrolysis of the ingredients of the mushroom powder

Raman microscopy:

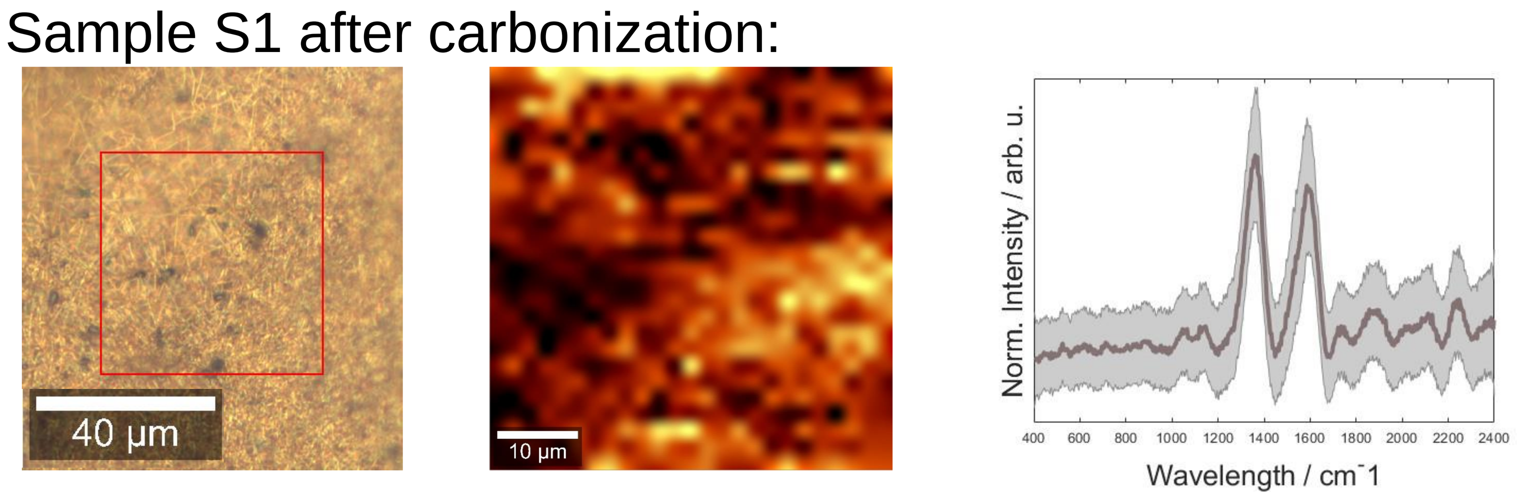
Sample S1 as-spun:

Topography



Wide-field False-color @2253 cm^{-1} Mean spectrum

Sample S1 after carbonization:



Wide-field False-color @1360 cm^{-1} Mean spectrum

I_D/I_G = 1.47 → high amount of defects during carbonization

Conclusion

- *P. ostreatus* powder could be embedded in PAN nanofiber mats for the potential use in biotechnological or biomedical applications
- Integrating *G. lucidum* powder was not possible
- Relatively low carbon yield after carbonization due to addition of mushroom powder

Literature

[1] Mishra, V.; Tomar, S.; Yadav, P.; Vishwakarma, S.; Singh, M. P. Elemental Analysis, Phytochemical Screening and Evaluation of Antioxidant, Antibacterial and Anticancer Activity of Pleurotus ostreatus through In Vitro and In Silico Approaches . *Metabolites* **2022**, *19*, 821

[2] Andrjc, D. C.; Knez, Z.; Marevci, M. K. Antioxidant, antibacterial, antitumor, antifungal, antiviral, anti-inflammatory, and nevro-protective activity of Ganoderma lucidum: An overview. *Front. Pharmacol.* **2022**, *13*, 934982

The 5th International Electronic Conference on Applied Sciences, December 04-06, 2024