

IN SITU POLYMERIZATION OF VINYL MONOMERS ON THE SURFACE OF FIBERS IN SELECTED NONWOVENS

References: 1. Czajka, M., Stawski, D., & Kudzin, M. H. (2025). *Polymer–Metallic Systems Functionalizing Polylactide Nonwovens as a Greener Alternative to Modified Polypropylene-Based Textiles*. **Coatings**, 15(9), 996. <https://doi.org/10.3390/coatings15090996>; 2. Stawski, D., Czajka, M., & Nowak, A. (2022). *Antibacterial Properties of Poly(N,N-Dimethylaminoethyl Methacrylate)*. **Royal Society Open Science**, 9(3), 211367. <https://doi.org/10.1098/rsos.211367>; 3. Kudzin, M. H., Stawski, D., & Czajka, M. (2020). *Biofunctionalization of Textile Materials. II. Antimicrobial Hybrid Materials Consisting of PLA Nonwoven Fabrics*. **Polymers**, 12(4), 768. <https://doi.org/10.3390/polym12040768>



Aim of the study

- The study aimed to functionalize PLA nonwoven fabric using DMAEMA and AIBN through in situ polymerization.
- The modification was intended to enhance the material's hydrophilic and thermal properties.
- Effectiveness was verified by FTIR, TGA, and hydrophilicity tests.

Methodology

Two modification methods were compared.

In situ polymerization directly on the PLA surface:



Sample ID	Mass increase [%]
1	1,49
2	2,41
3	3,78

Coating with a polymer solution by spraying:

Sample ID	Mass increase [%]
4	1,49
5	2,41
6	3,78



Results

FTIR spectrophotometric analysis

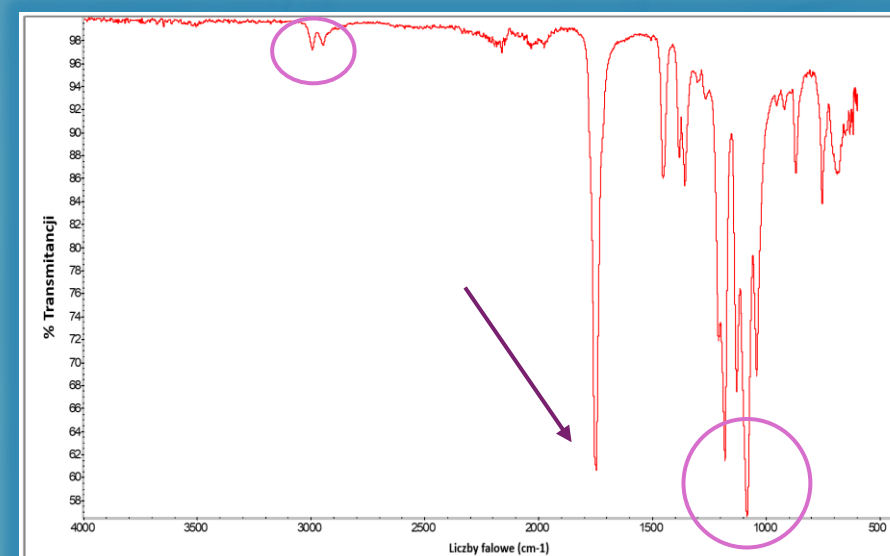
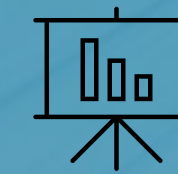


Fig. 1. FTIR spectrum of sample 1 (modified by the *in situ* method – mass increase of 1.49% from the first monomer solution with AIBN) of the PLA nonwoven in transmittance.

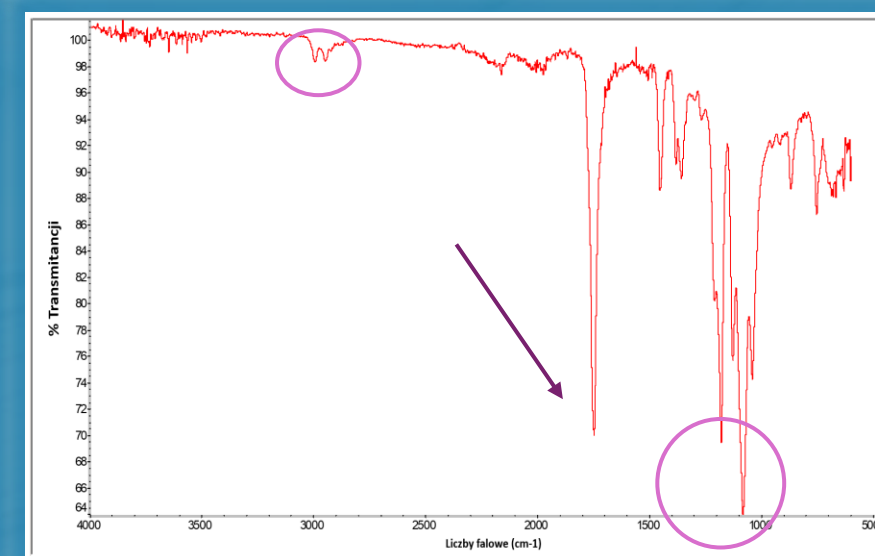


Fig. 2. FTIR spectrum of sample 4 (modified by the spraying method – mass increase of 1% from the first polymer solution in ethanol) of the PLA nonwoven in transmittance.

Thermogravimetric analysis (TGA)

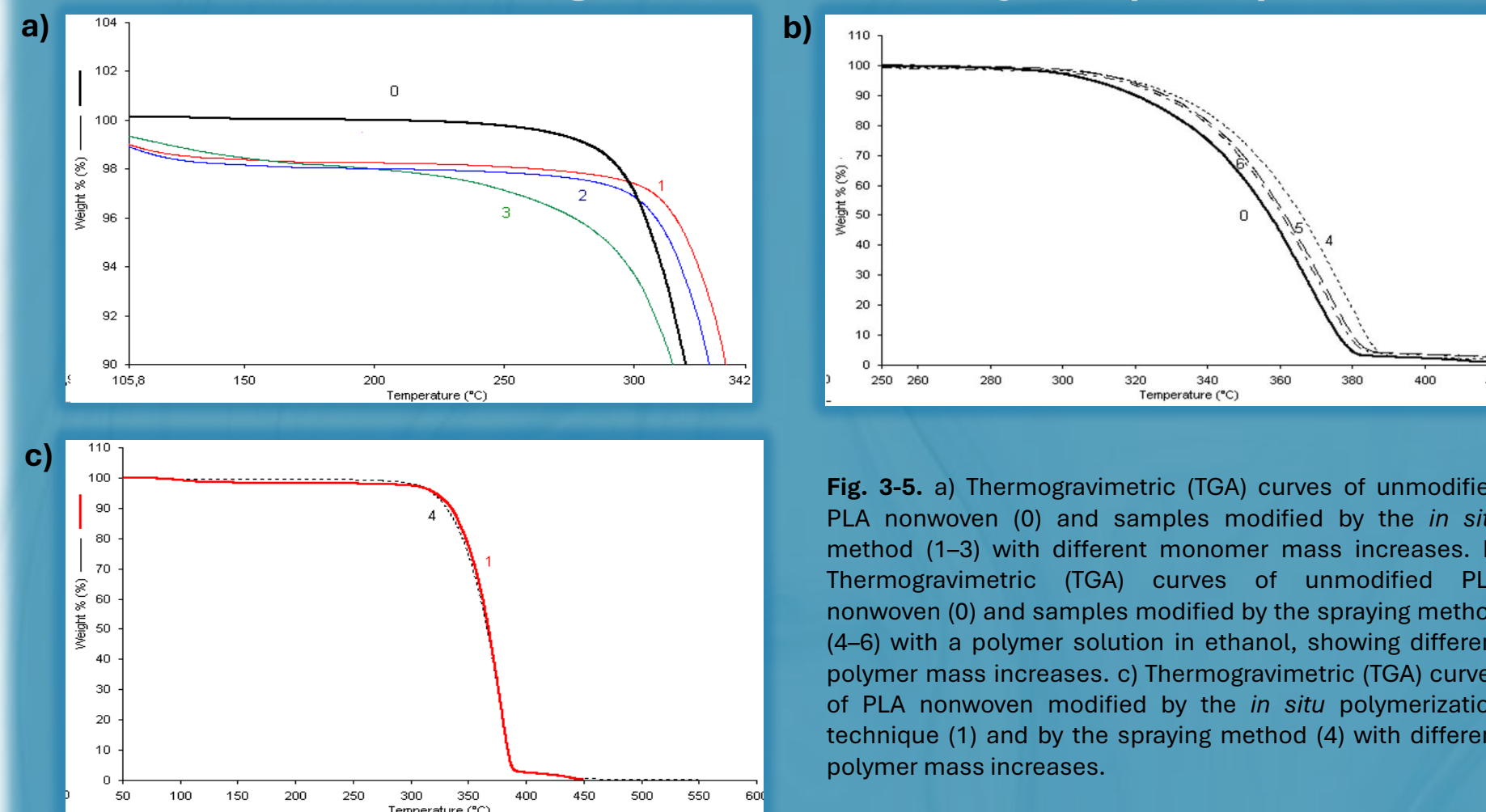


Fig. 3-5. a) Thermogravimetric (TGA) curves of unmodified PLA nonwoven (0) and samples modified by the *in situ* method (1–3) with different monomer mass increases. b) Thermogravimetric (TGA) curves of unmodified PLA nonwoven (0) and samples modified by the spraying method (4–6) with a polymer solution in ethanol, showing different polymer mass increases. c) Thermogravimetric (TGA) curves of PLA nonwoven modified by the *in situ* polymerization technique (1) and by the spraying method (4) with different polymer mass increases.

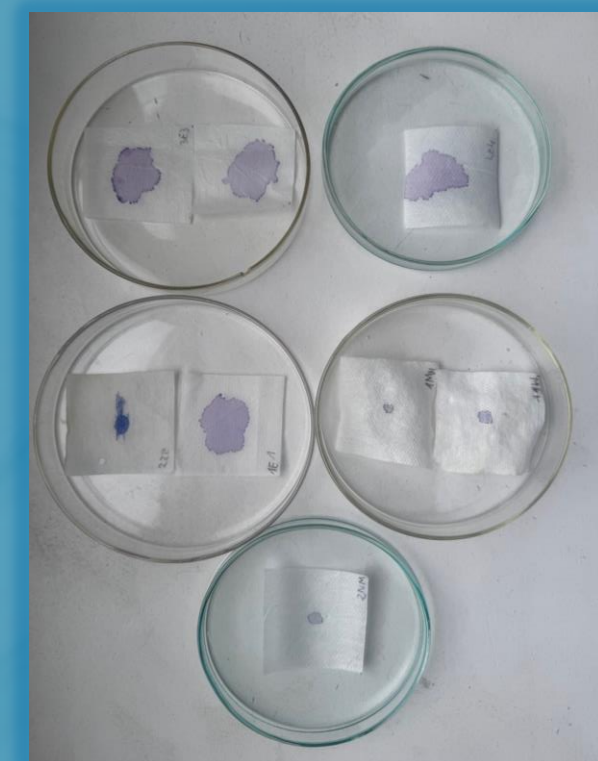
Hydrophilicity tests



Spraying enhanced PLA hydrophilicity and capillarity. Sample 5 had the highest water absorption (~886%), confirming the effect of modifier content.

Fig. 6. Photograph of a sample during water drainage (water absorption tests).

Fig. 7. Photographs of PLA samples after contact with methylene blue solution.



Conclusions

The spraying method proved most effective in enhancing the hydrophilicity and thermal stability of PLA nonwovens. *In situ* polymerization, though more demanding, ensures stronger and more durable fiber-modifier bonding, making it more suitable when high durability and chemical stability are required.

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