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Optimization of catechol-based surface modification

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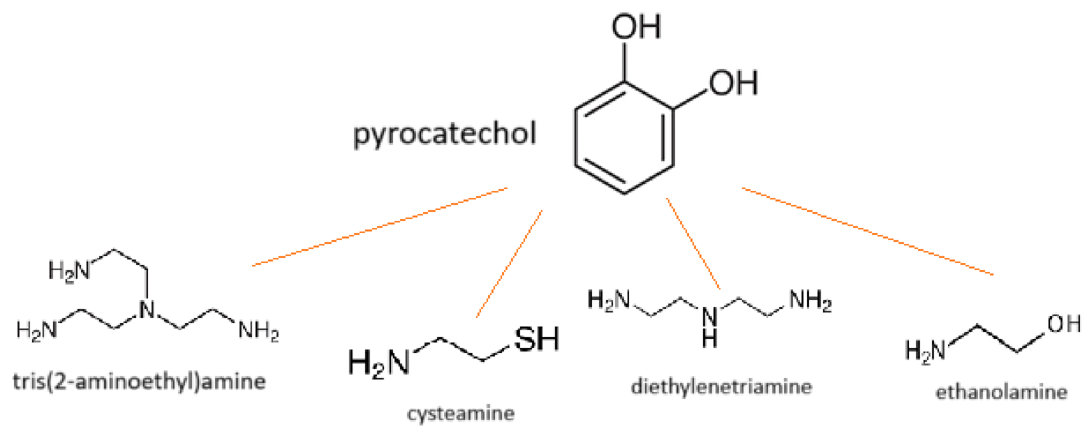
ABSTRACT

Functionalization of materials is a prevalent procedure because it allows materials to acquire new properties. The inspiration for developing a coating based on catechol comes from a protein derived from mussels that remain on rocks under conditions of constant exposure to water. The previously optimized coating of catechol with Tris(2-aminoethyl)amine (TAEA) for different textiles was tested. Various combinations of catechol with different chemical substrates were tested, and catechol–cysteamine coating was optimized.

METHODS

1. Catechol-based coatings and optimalization of reaction with cysteamine



Pyrocatechol is mixed with 4 different substrates in a molar ratio of 1:1,5 (left). The reaction with cysteamine was optimized according to the Table (right).

Time [h]	Pyrocatechol concentration [mmol]	Molar ratio (CAT: CYST)
24	1	0.5:1
		1:1
		1:1.5
		1:2
10	1	1:1 1:1.5 1:2
	2.5	1:1 1:1.5 1:2
	4	1:1 1:1.5 1:2
	5	1:1 1:1.5 1:2

2. Catechol – tris(2-aminoethyl)amine for different substrates

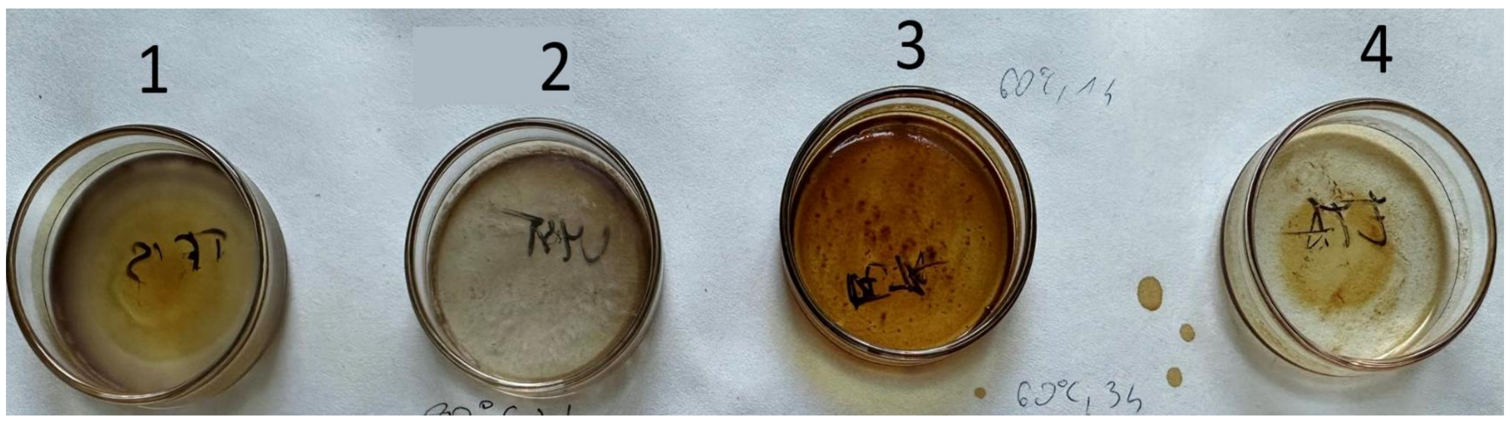
TESTED MATERIALS

- melamine formaldehyde foam,
- copper coated polyester nonwoven,
- nanofibrous polyamide membrane,
- flat sheet polyamide.
- Kevlar fibers,
- Spectra yarn,
- cotton fabric,
- glass filaments.

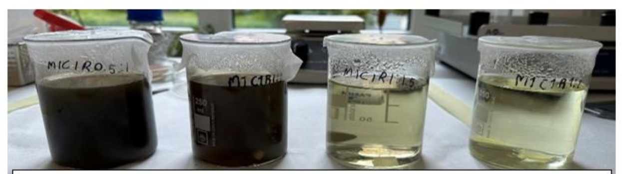
RESULTS AND DISCUSSION

1. Catechol – based coatings and optimalization of reaction with cysteamine

1. tris(2-aminoethyl)amine, 2. cysteamine, 3. diethylenetriamine, 4. ethanolamine



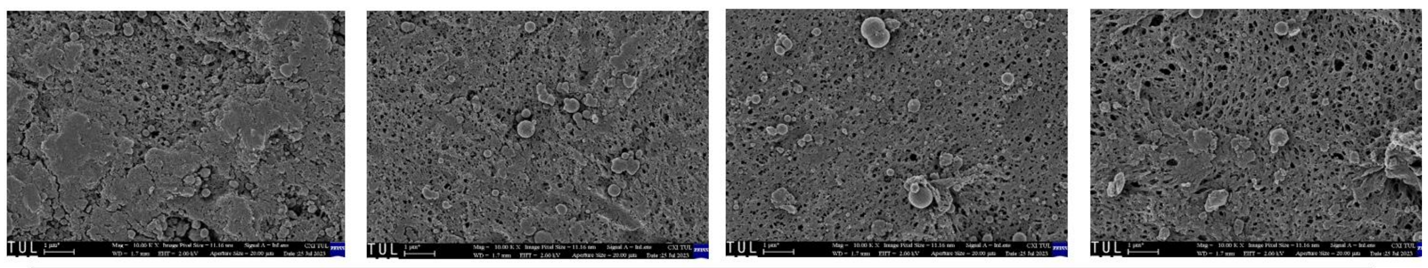
Time: 21 hours, 1 mmol pyrocatechol



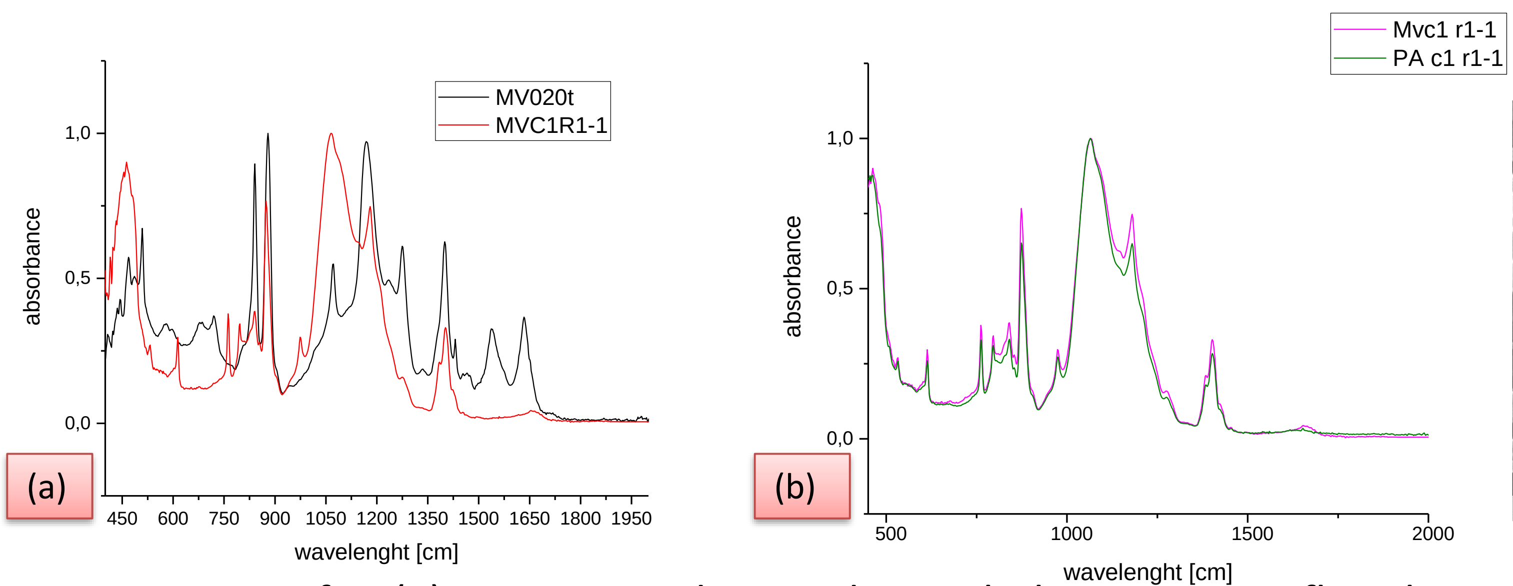
A) 0,5:1 B) 1:1 C) 1: 1.5 D) 1:2

Time: 10 hours, ratio 1:1

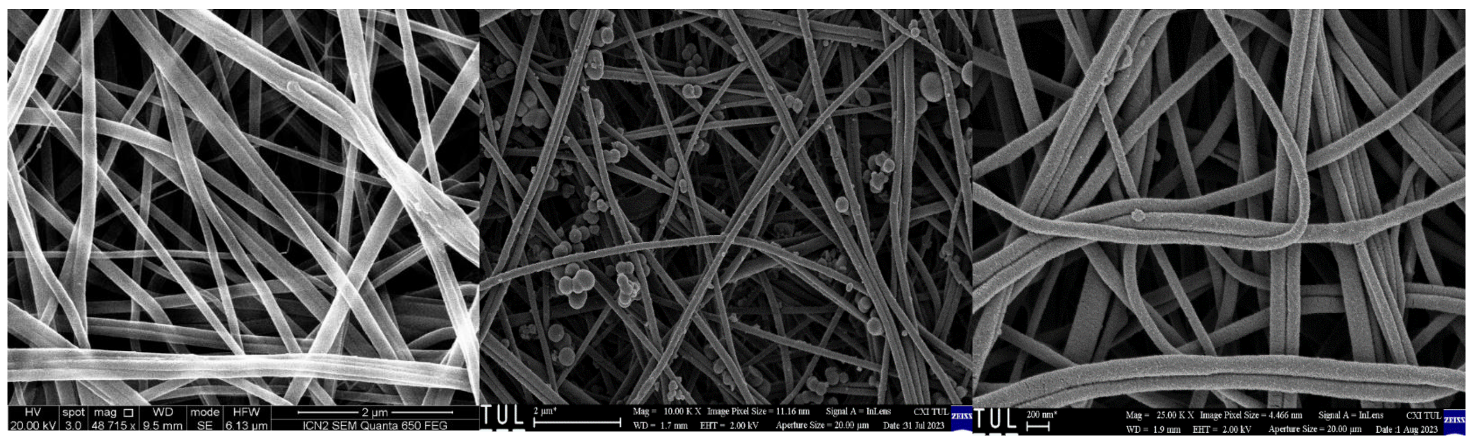
i) 1 mmol ii) 2.5 mmol iii) 4 mmol iv) 5 mmol



A) 0,5:1 B) 1:1 C) 1: 1.5 D) 1:2

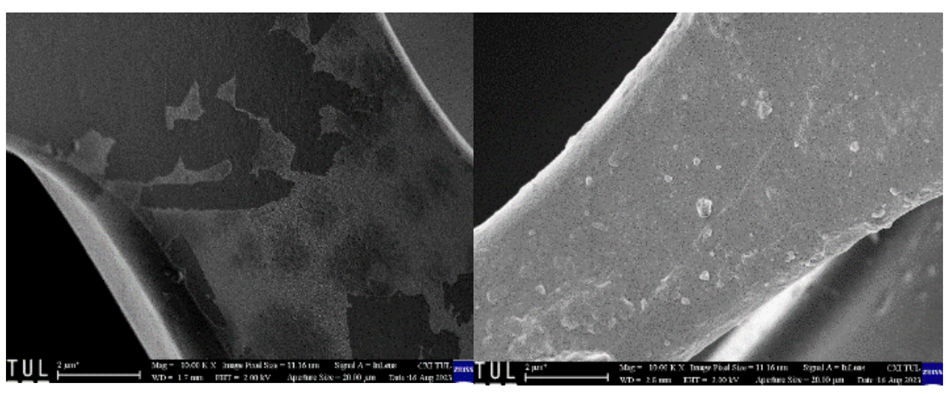


FTIR spectrum for (a) pristine and coated catechol-cysteamine flat sheet PVDF membrane, (b) modified PVDF nanofibrous and flat sheet membrane.

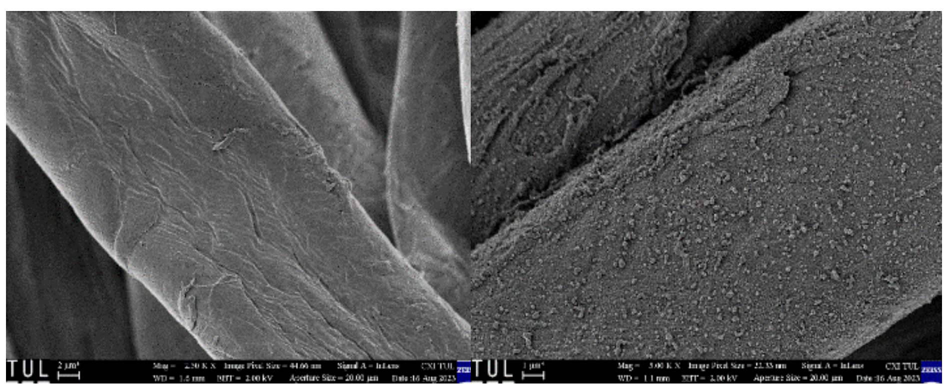


Pristinne PVDF nanofibers, during and after optimalization

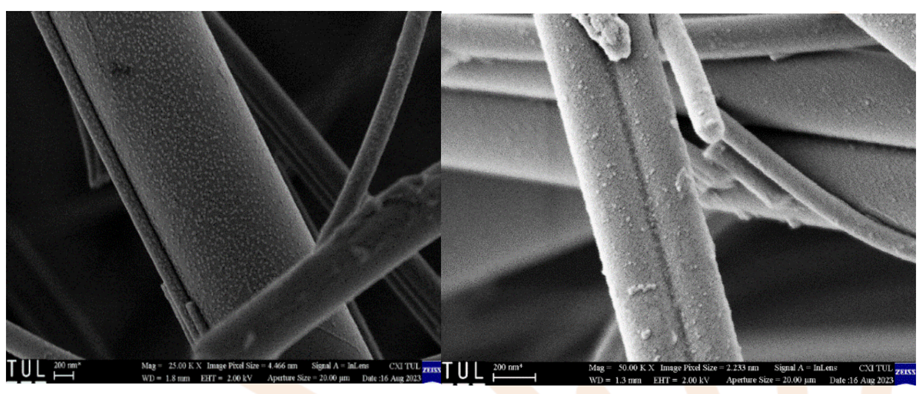
2. Catechol – tris(2-aminoethyl)amine for different substrates



melamine formaldehyde foam



cotton woven fabric



nanofibrous polyamide membrane

CONCLUSION

Catechol- based coatings are suitable for the various surfaces. It is possible to play and control coating properties by changing compounds that contain amine groups. By choosing the right substrate, it is possible to adjust coating properties according to desired goals or application.

REFERENCES

[1] Q. Lyu, et al. "The Chemistry of Bioinspired Catechol(amine)-Based Coatings," *ACS Biomater. Sci. Eng.*, vol. 5, no. 6, pp. 2708–2724, Jun. 2019, doi: 10.1021/acsbiomaterials.9b00281

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