

DEVELOPMENT OF POLYMER HYBRID COMPOSITE FILMS WITH TUNABLE WETTABILITY BY SURFACE MODIFICATIONS

Gianina Dodi¹, Doina Hritcu¹, Dan Draganescu¹, Vlad Carlescu², Mirabela L. Iordache¹, Marcel I. Popa¹

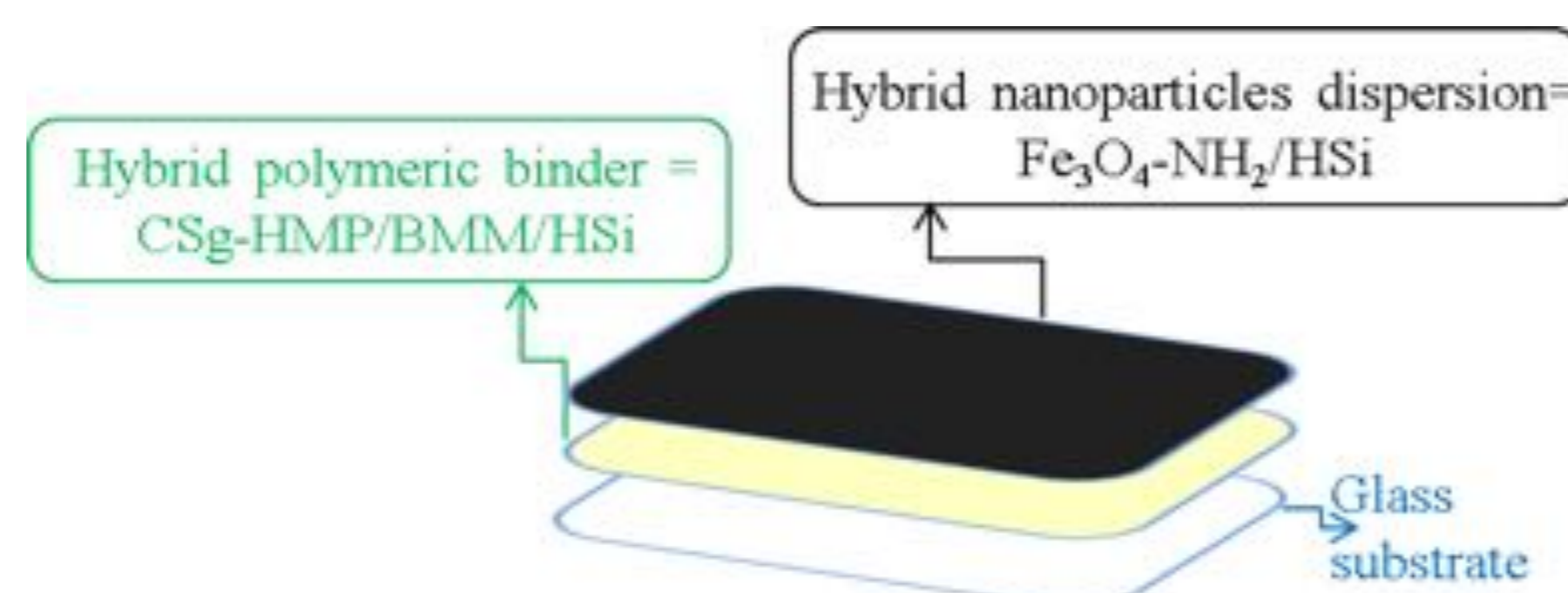
¹Faculty of Chemical Engineering and Environmental Protection, “Gheorghe Asachi” Technical University of Iasi, Romania, E-mail: impopa@ch.tuiasi.ro

² Department of Mechanical Engineering, Mechatronics and Robotics, “Gheorghe Asachi” Technical University of Iasi, Romania

AIM: Evaluate and compare the wetting behavior of hybrid composite coatings prepared with two different UV initiators for water-repellent applications.

FILM COMPOSITION:

Ist layer: Hybrid polymeric binder: chitosan bearing surface vinyl groups (CSg)¹ cross-linked with ethylene glycol dimethacrylate (EGDMA) using UV initiation (2-Hydroxy-2-methylpropiophenone (HMP) and benzoin methyl ether (BMM) /coupling agent- hexadecyltrimethoxy silane (HSi);



IInd layer: Hybrid nanoparticles dispersion= magnetite nanoparticles prepared by mild oxidation of ferrous ions in alkaline solution², followed by amination with (3-aminopropyl) triethoxysilane (Fe₃O₄-NH₂)/coupling agent HSi.

Coupling agent= pre-hydrolyzed/precondensed sol-gel solution of HSi³

Process parameter optimization

❖ Radical polymerization of CSg using HMP initiator

Batch	CSg (1% solid), mL	EtOH, mL	EGDMA, μL	HMP, μL
CSg-HMP1	2	1	12	12
CSg-HMP2	2	0.5	12	12
CSg-HMP3	2	1	24	24

❖ Radical polymerization of CSg using BMM initiator

Batch	CSg (1% solid), mL	EtOH, mL	EGDMA, μL	BMM, μL
CSg-BMM1	2	1	12	12
CSg-BMM2	1	0.5	12	12
CSg-BMM3	1	2	12	12
CSg-BMM4	2	1	24	24

Wetting angle versus hybrid polymeric binder composition: one layer

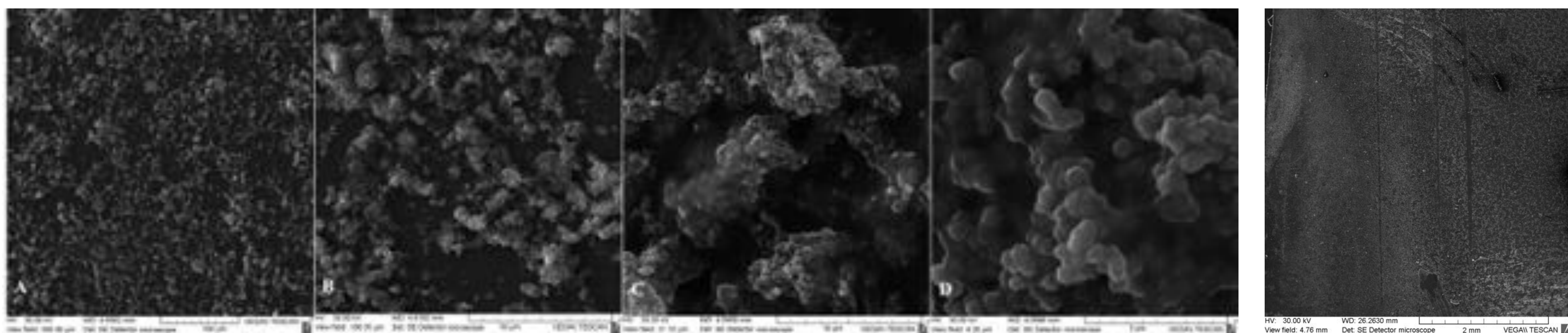
	Glass slide	CS	CS-HSi	CSg-HMP2/HSi	CSg-BMM1/HSi	CSg-BMM2/HSi	CSg-BMM3/HSi
Contact angle	78.1°		108.2°	115.9°	114.8°	113.5°	117.5°
Hysteresis	0	0	3.1°	1.9°	2.2°	1.6°	

Wetting angle versus coating morphology: layer-by-layer

	Glass slide	CS/HSi+Fe ₃ O ₄ -NH ₂ /HSi	CSg-BMM2/HSi+Fe ₃ O ₄ -NH ₂ /HSi
Contact angle			134.8°
Hysteresis		2.1°	2°

Coating morphology: layer-by-layer deposition of CSg-BMM2/HSi+Fe₃O₄-NH₂/HSi

Scratch test: critical adhesion load was 16.4 mN



Liquid droplets wetting/non-wetting capability



CONCLUSIONS

- ❖ Two different UV initiators were successfully used to evaluate and compare the wetting behavior of hybrid composite coatings for water-repellent applications.
- ❖ The addition of iron oxide nanoparticles during the curing stage and HSi sol-gel solution both into the matrix and the nanoparticle suspension produced surfaces with hydrophobic properties.
- ❖ The newly developed hybrid coating formulation is easy to apply by spraying and it has medium adherence to the substrate.
- ❖ Future work: ice-repellent studies.

Reference

1. G. Dodi et al., Chem. Eng.J., 203 (2012) 130–141.
2. G. Dodi et al., J. Magn. Magn. Mater., 388 (2015) 49–58.
3. Spirk et al., Carbohydr. Polym., 93 (2013) 285–290