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From Hydrophobic to Superhydrophilic Electrospun Surfaces

Carolina Fracalossi Rediguieri[1, 2*], Natalia Neto Pereira Cerize[3], Maria Helena Ambrosio Zanin[3], Adriano Marim de Oliveira[3], Terezinha de Jesus Andreoli Pinto[1]
[1, 2]Faculdade de Ciências Farmacêuticas da Universidade de São Paulo, São Paulo, Brazil
[2]Agência Nacional de Vigilância Sanitária, Brasília, Brazil
[3]Instituto de Pesquisas Tecnológicas, São Paulo, Brazil
*rediguieri@yahoo.com.br, ncerize@ipt.br, mhzanin@ipt.br, amarim@ipt.br, tjapinto@usp.br

Extended Abstract

Scope:

Superhydrophilic surfaces are those that exhibit water contact angle close to 0°. Most applications include microfluidic devices and household appliance, mainly because of their antifogging and antifouling properties. Generally, superhydrophilicity is achieved by adding strong polar group and/or roughness to the surface [1][2][3]. Electrospinning of polymeric solutions is well known to produce highly porous 2D-structures. PCL is a biodegradable hydrophobic polyester used as additive of resins, in the manufacture of polyurethanes and in 3D printers (because of its low melting point, 60°C). In addition, it is commonly used as biomaterials (because of its biocompatibility) and as scaffolds for tissue engineering; however, it exhibits very hydrophobic surface. Poloxamer 407 (Pluronic® F-127) is a non-ionic surfactant composed of poly (ethylene oxide) (PEO)–poly (propylene oxide) (PPO) copolymer. It is commonly used as vehicle for drug delivery and in cell culture applications [4][5]. Therefore, the aim of this study was to fabricate and compare electrospun surfaces properties of PCL and PCL/poloxamer mats.

Methods:

PCL mats were fabricated by electrospinning with different concentrations of poloxamer 407. Briefly, PCL (80 MW) was dissolved in chloroform/methanol (3:1) at a concentration of 8% (w/v). Poloxamer 407 (Pluronic® F-127) was added at 0, 2.5, and 5% (w/w). The polymeric solutions were electrospun at 1.0 mL/h, 16.5 KV and 15 cm distance between needle and collector. Physicochemical characteristics (contact angle, FTIR and DSC/TG), morphology (porosity and SEM), antifouling, and mechanical properties of polymeric mats were investigated.

Results/discussion:

The electrospinning process resulted in fibers with diameters in the micro and nanometer range and porosity of 90% in all three mat types. The water contact angle (WCA) measurement showed a high increase of hydrophilicity in mats containing poloxamer. PCL mats presented average θ=131° up to 60 seconds after depositing the water drop on the surface. In contrast, in PCL mats containing 2.5% or 5% of poloxamer the water drop had totally spread over its surface ($\theta \sim 0°$) less than one second after being deposited over the mat. Although the small amount of poloxamer was enough to highly decrease the water contact angles on the mats, FTIR was not able to detect the poloxamer in the hybrid mats, but PCL only. Thermogravimetry analysis showed a decrease in onset decomposition temperature with increasing poloxamer concentration in fibers. Even though the difference was statistically significant between groups (ANOVA, $p=0.047$), the difference between PCL and PCL/Poloxamer 5% onset decomposition temperatures was only four degrees Celsius (374°C and 370°C, respectively), which is not a large difference in practice. Other thermogravimetric parameters such as peak of decomposition, endset decomposition temperature and percentage of decomposition were not different among groups (ANOVA, $p > 0.05$). Other results will be presented in the conference. However, results presented so far indicate that electrospinning technique and the addition of poloxamer to PCL were good strategies to produce superhydrophilic surfaces. Also, the poloxamer highly increased hydrophilicity of PCL mats without hampering other morphological or physicochemical properties.

References

[1] E. Ueda and P. A. Levkin, "Emerging Applications of Superhydrophilic-Superhydrophobic Micropatterns," *Adv. Mater.*, vol. 25, no. 9, pp. 1234–1247, 2013.

[2] J. Drelich, E. Chibowski, D. D. Meng, and K. Terpilowski, "Hydrophilic and superhydrophilic surfaces and materials," *Soft Matter*, vol. 7, no. 21, p. 9804, 2011.

[3] P. Patel, C. K. Choi, and D. D. Meng, "Superhydrophilic Surfaces for Antifogging and Antifouling Microfluidic Devices," *J. Assoc. Lab. Autom.*, vol. 15, no. 2, pp. 114–119, 2010.

[4] H. R. Patel, R. P. Patel, and M. M. Patel, "Poloxamers: A pharmaceutical excipients with therapeutic behaviors," *Int. J. PharmTech Res.*, vol. 1, no. 2, pp. 299–303, 2009.

[5] J. J. Escobar-Chávez, M. López-Cervantes, a. Naïk, Y. N. Kalia, D. Quintanar-Guerrero, and a. Ganem-Quintanar, "Applications of thermo-reversible pluronic F-127 gels in pharmaceutical formulations," *J. Pharm. Pharm. Sci.*, vol. 9, no. 3, pp. 339–358, 2006.