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Thin and ordered hydrogel films deposited through electrospinning technique; a simple and efficient support for organic bilayers

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ABSTRACT: Thermal behavior of Dipalmitoylphosphatidylcholine (DPPC) bilayers deposited over hydrogel fibers was examined. Thus, membrane stability, water absorption-release, phase transitions and phase transition temperatures were studied through different methods during heating cycles. Hydrogel films were realized using an oligomer mixture (HEMA-PEGDA$_{575}$/photo-initiator) with adequate viscosity. Then, the fibers were deposited over silicon wafers (hydrophilic substrate) through electrospinning technique using four different voltages: 15, 20, 25 and 30 kV. The films were then exposed to UV light, favoring polymer chain crosslinking and interactions between hydrogel and substrate. For samples deposited at 20 and 25 kV, hierarchical wrinkle folds were observed at surface level, their arrangement distribution depends directly on thickness and associated point defects. DPPC bilayers were then placed over hydrogel scaffold using Langmuir-Blodgett technique. Field Emission Scanning Electron Microscopy (FE-SEM) analysis were used to investigate sample surface, micrographies show homogeneous layer formation with chain polymer order/disorder related to applied voltage during hydrogel deposition process, among other parameters. According to the results obtained, it is possible to conclude that the oligomer deposited at 20 kV produce thin homogenous films (~ 40 nm) with enhanced ability to absorb water and release it in a controlled way during heating cycles. These scaffold properties confer to DPPC membranes thermal stability, which allow an easy detection of phase(s) and phase transitions. Thermal behavior was also studied via Atomic Force Microscopy (roughness analysis). Contact angle measurements corroborate system wettability, supporting the theory that hydrogel thin films act as DPPC membrane enhancers for thermal stability against external stimuli.

Keywords: Electrospinning, ellipsometry, hydrogel wrinkled film, DPPC bilayer, biomimetic membrane, phospholipid bilayer stability.

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