

STRUCTURED PEG-DEXTRAN SURFACES FOR BIO-APPLICATIONSN.Blondiaux¹, S.Jeney², M.Liley¹, R.Pugin¹, H.Sigrist¹, H.Heinzelmann¹ & N.D.Spencer³¹Centre Suisse d'Electronique et de Microtechnique (CSEM), Neuchâtel, Switzerland.²Institute of Physics of Complex Matter, EPFL, Lausanne, Switzerland.³Dept. Of Materials, ETHZ, Zürich, Switzerland

INTRODUCTION: Polyethylene-Glycol (PEG) / Dextran aqueous biphasic systems have been widely studied in solution for cell and macromolecule separation [1]. The demixing properties of PEG and Dextran were here exploited to create structured polymer thin-films by polymer demixing. Polymer demixing exploits the ability of a solution of two different homopolymers to phase separate and form micro- to nano- structured films when spread on a substrate. Use of the technique to create structured polymer films was previously reported [2] but has been here extended to water-soluble polymers.

METHODS:

The two polymers were first diluted in water (the common solvent). Polymer blend solutions were then spin-coated on silicon wafers, leading to a polymer film composed of dextran-rich and PEG-rich domains. The size of the structures could be tuned adjusting parameters such as the polymer ratio (PEG:Dextran from 50:50 w/w to 90:10 w/w), the initial polymer blend concentration (from 0.5 %wt to 5 %wt), spin-speed (from 2000 rpm to 5000 rpm) and polymer molecular weight (from 5 kDa to 100 kDa for both polymers). A selective solvent was also used to remove one of the two polymers, thus coarsening the structures. The structured films were then characterized using Atomic Force Microscopy (AFM) or fluorescence microscopy.

RESULTS & DISCUSSION:

The phase-decomposition of asymmetric PEG/Dextran polymer blends follows a nucleation & growth process. Dots of Dextran embedded in a matrix of PEG can thus be seen on the surface (figure 1). The size of the structures was found to increase with the solution concentration and decrease with the spin velocity. The molecular weight also influences the demixing process since it affects the viscosity of the solution.

Fig. 1: Typical AFM image of PEG-Dextran polymer blend demixing: PEG 77k / Dextran 70k, 80/20, 2%wt diluted in H₂O spin coated at 5000 rpm on hydrophilic Substrate.

POTENTIAL APPLICATIONS:

The water-solubility and the biocompatibility of the polymer used make biological applications possible. First experiments were tried adding proteins to the polymer blend. When phase separation occurs, the protein goes preferentially in the dextran phase. This can be an interesting way to pattern proteins on surfaces, combining both structuring (with polymer demixing) and functionalisation (with the protein). Potential application may be found for instance in activation or passivation of surfaces (cell or bacteria adhesion) [3].

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ACKNOWLEDGEMENTS: This work was supported by POLYNANO European network.

