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Study of the Air-Water Interfacial Behavior of Block Polymer Micelles: Toward Rational Design of Polymer Lung Surfactants HYUN CHANG KIM, YOU-YEON WON, Purdue University — Lung surfactants play a critical role in the lung's ability to process air by lowering alveolar surface tension. For potential lung surfactant applications, we have been testing a wide range of block copolymer micelles to identify candidate materials that are capable of replicating the surface-tension-lowering properties of natural lung surfactants. This talk will discuss the results obtained from two representative systems: aqueous micelles formed by PLGA-PEG and PS-PEG block polymers. Water-spread PLGA-PEG micelles form stable monolayers at the air-water interface. However, PLGA-PEG micelles are not strongly bound to the air-water interface, and thus unable to produce low surface tension (<about 10 mN/m) at high compression. Experiments suggest that the tendency of PLGA-PEG micelles to submerge into the water subphase is controlled by such parameters as the molecular weight and grafting density of the PEG brush chains, and the curvature of the PEG grafting surface. This behavior can be precisely modeled by the Daoud-Cotton theory. In contrast, we found that water-spread PS-PEG micelles are typically completely pinned to the air-water interface, and thus are able to produce an extremely low surface tension (close to 0 mN/m) at high compression. The exact origin of this behavior is not understood yet. We suspect that the PEG brush chains in PS-PEG micelles are less hydrated than in ordinary PEG brush situations, prohibiting the micelles from submerging into the aqueous phase. Transverse proton NMR relaxation measurements support this explanation.

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