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Buckling, Bimolecular Layers and Anisotropic Arrays : Stages in Langmuir Monolayer (LM) Collapse

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Abstract — Langmuir monolayers of stearic acid on Co-ions in the aqueous subphase have been deposited at different stages of collapse, on Si(001) wafers using a modified version of Inverse Langmuir-Schaefer method of horizontal transfer. The deposited films have been studied with X-ray reflectivity (XRR) and atomic force microscopy (AFM). The electron density profiles (EDPs) along the depth of the deposited films have been extracted from XRR data. Immediately before collapse, the film is a buckled monolayer with the Co-bearing headgroups of molecules touching the substrate and hydrocarbon tails in air. The buckling amplitude is small and in-plane topography, obtained from AFM, is smooth with very few 'ridges' remaining roughly normal to the compression direction. Immediately after collapse, there is no buckling but the film is a bimolecular layer, where the lower mono-molecular layer is compact, and the upper mono-molecular layer has a low (about 7%) coverage with molecules having tails placed symmetrically about the headgroups. The number of 'ridges' increases but is still small and the ridge height remains almost unchanged. Further ahead in collapse, the film is still a bimolecular layer with much higher (about 30%) upper layer coverage. The number of 'ridges' increases considerably and the heights become almost double. Moreover, the 'ridges' break up into arrays of 'dots', about 2.0 μm in diameter. The losses in area suffered by the Langmuir monolayer at different stages of collapse are almost explained by the bimolecular layer formation.