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Newtonian to non-Newtonian flow transition in lung surfactants AMIR SADOUGHI, AMIR HIRSA, Rensselaer Polytechnic Institute, JUAN LOPEZ, Arizona State University — The lining of normal lungs is covered by surfactants, because otherwise the surface tension of the aqueous layer would be too large to allow breathing. A lack of functioning surfactants can lead to respiratory distress syndrome, a potentially fatal condition in both premature infants and adults, and a major cause of death in the US and world-wide. We use a home-built Brewster angle microscope on an optically accessible deep channel viscometer to simultaneously observe the mesoscale structures of DPPC, the primary constituent of lung surfactant, on water surface and measure the interfacial velocity field. The measured interfacial velocity is compared to Navier-Stokes computations with the Boussinesq-Scriven surface model. Results show that DPPC monolayer behaves i) purely elastically at low surface pressures on water, ii) viscoelastically at modest surface pressures, exhibiting non-zero surface shear viscosity that is independent of the shear rate and flow inertia, and iii) at surface pressures approaching film collapse, DPPC loses its fluid characteristics, and a Newtonian surface model no longer captures its hydrodynamics.

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