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The influence of surfactant on the stability of a liquid bilayer inside a rigid tube[1] YUANYUAN SONG, DAVID HALPERN, University of Alabama, JAMES GROTBERG, University of Michigan — Many airways in the lung are coated with a bilayer consisting of a serous layer adjacent to a more viscous mucus layer which is contiguous with the gas core. An instability due to high surface tension at the interfaces may lead to the formation of a liquid plug that blocks the passage of air. This phenomenon is known as airway closure. Here we investigate the linear stability for the case when the thin liquid bilayer is Newtonian and coated within a rigid tube with the presence of an insoluble surfactant monolayer at the mucus-gas interface. Surfactant affects the surface tension and also induces a surface stress at the interface. A system of equations for the deflections of the interfaces and the surfactant concentration is derived by using lubrication theory. These equations are linearized, and by applying the method of normal modes, a dispersion equation for the growth rate of the disturbances is obtained. Its dependence on the viscosity ratio, the thickness ratio of the two liquid layers, the base state surface tension ratio, and the Marangoni number is investigated, and comparisons with previous single layer models are discussed.

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