Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Superlubricity of a natural polysaccharide from the alga Porphyridium sp. DELPHINE GOURDON, Department of Chemical Engineering, UC Santa Barbara, QI LIN, EMIN OROUDJEV, HELEN HANSMA, Department of Physics, UC Santa Barbara, JACOB ISRAELACHVILI, Department of Chemical Engineering, UC Santa Barbara — Using a surface forces apparatus we have studied the adhesive and lubrication forces of mica surfaces separated by a molecularly-thin, sub-nanometer, film of a high molecular weight (2.6 MDa) naturally occurring anionic polysaccharide adsorbed from aqueous solution. The adhesion and friction forces of the biopolymer were monitored as a function of time, shearing distance and driving velocity under a large range of compressive loads. Although the thickness of the confined biopolymer was <1 nm, the friction was ultra-low (coefficient of friction = 0.015) at pressures up to 100 atm and over 4 decades of velocity with no wear. Complementary atomic force microscopy imaging in solution shows that the biopolymer adsorbs well to the mica surface but remains mobile and easily dragged upon shearing. The good adsorption of this polysaccharide to negatively charged surfaces, its low friction, its robustness (high-load carrying capacity and wear protection), as well as the weak (logarithmic) dependency of the friction on the sliding velocity make it, or this class of polyelectrolytes, excellent candidates for use in water-based lubricant fluids and as potential additives to synovial fluid in joints and other biolubricating fluids. The physical reasons for the tribological properties of this polysaccharide will be discussed.

Delphine Gourdon

Date submitted: 01 Dec 2004 Electronic form version 1.4