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Oscillatory tribology performed with a commercial shear rheometer

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Abstract

Here, we introduce a custom-made setup which allows for performing oscillatory friction measurements using a commercial shear rheometer as a technical platform. The presented measuring head can hold both artificial and biological materials as probing pins, and the sample holder is designed such that it enables measurements on a broad range of materials including technical materials such as steel and PTFE, kidney-shaped PDMS layers, and cylindrical cartilage tissue samples. Control measurements performed with an established rotational tribology setup demonstrate that the friction coefficients obtained both in the presence and absence of macromolecular lubricants agree very well with those published in the literature. Finally, we show pilot experiments in which we probe friction at the lateral interface between two different materials. For this interfacial tribology geometry, we also quantify wear generation by means of optical profilometry.

Keywords: Friction, lubrication, wear, cartilage, PDMS, mucin

1. Introduction

In many fields of materials science, testing the behavior of two objects that rub against each other is an important step in the material development process. Especially if the mechanical contact between two different material surfaces persists for extended time periods, friction and wear formation need to be considered^{1,2}. As a consequence, there are a multitude of established tribological setups and characterization protocols which are commonly used to investigate the friction and wear properties of artificial materials.³⁻⁸ However, friction and wear formation are not limited to technical materials; they also occur for biological materials.⁹⁻¹³ Whereas a replacement of defective parts is often possible in technical settings,

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