Proceeding of the ASME 2020
Conference on Information Storage and Processing Systems
ISPS2020
June 25-26, 2020, Milipitas, CA, USA

ISPS2020-1938

TRIBOLOGY CHARACTERISTICS BETWEEN POLYMER NANOSHEETS AND HUMAN SKIN

Shunsuke Nakano[1], Sheng Zhang[2], M. Danial Ibrahim[3], Yuta Sunami[1]

[1]Tokai University, Japan
[2]Zhejiang University, China
[3]Universiti Malaysia Sarawak, Malaysia

ABSTRACT

*The purpose of this study is to investigate the contact mechanism between nanosheets and human fingertip skin controlled to tens of nanometers in terms of friction coefficient under two different conditions, dry and immersed is. Nanosheets of various thicknesses with controlled film thickness were prepared, and the frictional force between the nanosheets and the fingertip was measured using a three-component dynamometer. The contact area was observed with a prism and the contact area ratio was calculated. From the experimental results, comparing the friction coefficient and the contact area ratio of the polymer nanosheet, it was found that the contact area ratio increases as the friction coefficient decreases. In addition, a much higher coefficient of friction was observed during drying than when immersed in water, and the coefficient of friction increased slightly with increasing load during immersion. Therefore, the findings of this study could contribute to the study of nanosheet materials and other skin applications.*Keywords:
Keywords: Polymer nanosheet, Friction, Finger,

INTRODUCTION

Attention has been focused on ultra-thin polymer films (hereafter referred to as nanosheets) whose thickness is controlled to several tens of nm, which has features such as high flexibility and high adhesiveness. Because the nanosheet has a very large surface area with respect to its thickness, it can be stuck on complex uneven surfaces without using an adhesive. Therefore, it is expected to be applied to devices to be attached to the skin such as wearable electronic devices such as substrates and wound dressings. It can be predicted that the ultra-thin substrate of wearable electronic equipment will enable ultra-miniaturization without changing the function, leading to weight reduction and cost reduction. For this reason, nanosheets can be applied to a wide range of research fields.Okamura et al.[1] developed a nanosheet that can be stuck inside a living body without causing the human body to reject the reaction by using polylactic acid, which has characteristics such as biocompatibility and biodegradability, as a material. In addition, T. Fujie et al.[2] performed lung repair of animals using nanosheets, and are expected to be applied to humans in the future. Therefore, nanosheets are expected to be widely used in the medical field. In particular, in nanosheet technology for biomedical applications, the effects of friction and abrasion with the skin are considered to be very large as a thin film sensor or wound dressing material attached to the skin.Skin friction characteristics are closely related to skin condition. Dry skin has a low coefficient of friction, and moist skin has a large coefficient of friction. In addition, the friction changes greatly depending on the texture and softness of the skin. This suggests that it is very important to know the frictional properties between the nanosheet and the skin when considering its application to living organisms. Therefore, the purpose of this study was to elucidate the tribological properties between the nanosheet and human skin, fabricated nanosheets, and examined the contact mechanism from the viewpoint of the friction coefficient under two conditions: drying and immersion.

1 EXPERIMENTAL MRTHOD

1.1 NANOSHEET PREPARATION METHOD

Nanosheets were produced by applying micro gravure printing[3] and sacrificial film methods to a thin film coating machine. The sacrificial film method[1][2] is a process that can remove nanosheets by removing an intermediate layer formed between two layers (substrate and nanosheet). Table 1 shows the manufacturing conditions. When coating, the material to be diluted must be in solution and placed in a solution tank. The following describes the polymers used and their solvents. First, polyvinyl alcohol (hereinafter referred to as PVA) was used for the intermediate layer. Since PVA is water-soluble, ultrapure water was used as the solvent. At this time, the solution concentration of PVA / ultra-pure water is 20 mg/ml. Next, PDLLA was used as the nanosheet material and chloroform was

