The Effects of Wear on Triboelectric Charge Transference in Sliding F-TENG Contacts

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In this article a novel sliding-freestanding-triboelectric-layer triboelectric-nanogenerator (F-TENG) contact is replicated in a reciprocating tribometer environment. A variety of metal-on-polymer surface pairings are utilised to compare how differing material properties affect triboelectric charge transfer with counter-surfaces. The longevity of TENG devices are also brought into question, as tribological testing reveals a reduction in output performance over time directly related to material wear within the TENG contact. A correlation between contact force, contacting surface topographies, and triboelectric surface charge density is further clarified.

Keywords: Triboelectric Nanogenerator, Contact Electrification, Surface Topography, Wear

1. Introduction

Triboelectric nanogenerators (TENGs) are a family of devices originally created [1] as a way to convert otherwise wasted kinetic energy from mechanical processes into electrical energy. TENGs achieve this through the coupling of electrostatic induction and triboelectric charge transfer [2]; the latter being described as the transference of electronic charge between materials through physical contact [3]. Much of the current research into TENGs fails to consider the effects of tribological processes on their performance and longevity [4] therefore a more rigorous tribological analysis of TENGs will greatly aid in the optimisation of their operation.

2. Methods

An F-TENG contact – consisting of an upper insulating surface sliding laterally between the surfaces of two conductive lower surfaces – has been replicated within a reciprocating tribometer environment. The two conductive samples are connected to an electrometer in order to measure the properties of any electrical current which would pass between them. As the upper and lower samples come into physical contact, an electronic charge is transferred to and becomes isolated within the insulating surface through contact electrification. As the upper sample is reciprocated between the two conductive surfaces, the relative movement of this isolated charge and the conductive surfaces induce an alternating current through the electrometer.

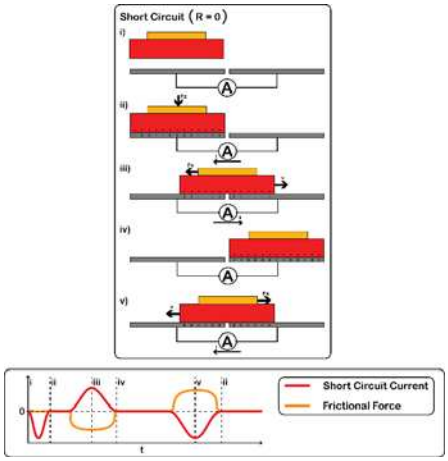

Fig.1 – Schematic representation of the F-TENG contact with the electrometer configured to measure short-circuit current.

3. Discussion

Tribological tests using the UMT-TENG apparatus reveal that the wear of both polymer and metal contacting materials inhibit triboelectric charge transfer. This is shown through evidence of abrasive wear on the polymer surfaces in addition to the presence of polymer transfer films confirmed through FTIR analysis and monochromatic light interferometry.

4. References

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