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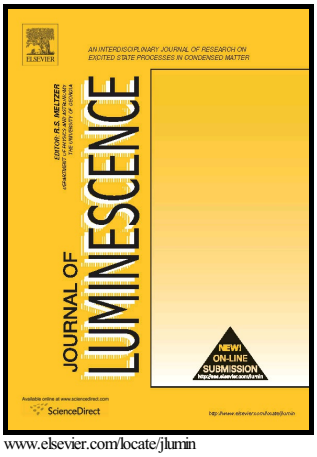

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Triboluminescence modulated by humidity

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ABSTRACT

Triboluminescence (TL) reflects the characteristics of real-time optical signals generated in the process of friction, hence can be promising in real-time monitoring and surface study. By studying the sliding between SiO_2 and Al_2O_3, we found that triboluminescence (TL) can be modulated quantitatively by modifying ambient humidity. The trend of TL intensity varies at different ranges of humidity and there exists a critical humidity. TL intensity rises initially and reaches its peak at critical humidity before it diminishes and eventually decreases to zero. It results from the decrease of energy barrier of tribo-charging and increase of electric field intensity below critical humidity, and for humidity above critical humidity, the rapid growth of surface conductivity and a shorter distance account for smaller possibility of gas collision.

Keywords: triboluminescence; humidity; water layers; conductivity; electrical field

1. INTRODUCTION

Triboluminescence (TL) refers to the emission of light in friction [1]. It is easy to generate and applies to a quantity of materials [2,3]. The observation of TL was first recorded in "The Advancement of Learning" in 1605 (ref. 4). There used to be divergence of views on the mechanism of TL, and it has long been discussed and investigated. The studies on electrons emission [5], tribo-electrification [6-8], kinetics [9] and charge localization on surfaces [10] etc. during the contacts like friction, have been well discussed, providing theoretical basis for the interpretation of TL. Besides, the introduction of the photomultiplier tube (PMT) to TL study developed a technique for measuring the emissions quantificationally [3].

Early before in 1978, B. P. Chandra proposed that the mechanism of TL is the discharge of gases between newly-created surfaces during fractures in the study of tartaric acid, sugar and six other crystals [11]. He further concluded that the TL intensity in these crystals comprises two parts, which is the TL owing to the luminescence property of crystals themselves, and the TL resulting from the discharge of gases where new surfaces are created [11]. Later in 1981, Zink discovered that fracture as well as polar space groups are required in TL, and that the pressure at the emitting position should be comparatively low, so the mechanism ought to coincide with these