P11 Spectroscopic Measurement of Faint Light Produced by Rapid Separation of an Adhesive Tape

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ABSTRACT

This paper describes results on experimental study of faint light emission proced by separation of an adhesive tape from a glass or a polymer film. Spectroscopic measurement of the faint light was carried out using a monochromator and a phcmultiplier. The results indicated that the light emission was caused by discharges near the tape-air-glass triple junction. We found that the frequency of the light emission wastrongly changed by changing the peeling speed of the tape. Surface potential distributions on the film after peeling were also measured by a XY-movable probe and an electrtatic voltmeter. The surface potential on the film after the fast-speed peeling became slightly higher than that on the film after the low-speed peeling.

KEYWORDS: adhesive tape, discharge, peeling speed, electrical double layer

1. Introduction

Adhesive tapes are widely used in various fields.

manufacturing, medical, construction, transport…

One of problems for the use of tapes → Light emission caused by peeling

It induces not only uncomfortable feeling for users but also defects for some products in manufacturing processes

The mechanism of the light emission is still not clear because the physical condition at the interface is very complex.

→ Discharge lihgt ?
or
Mechanoluminescence due to rapid deformation?

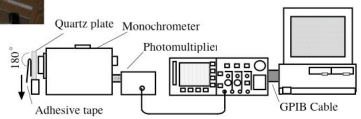
The purpose of this study is to clarify the mechanism of the light emission caused by peeling of an adhesive tape.

2. Experimental method

(1)Spectroscopic measurement of the faint light

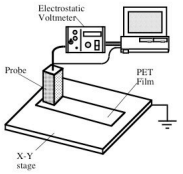
If the light emission is caused by discharges, spectrum of the light must be in agreement with that of air discharge light.

We measured the repetitive faint light during the peeling of an adhesive tape from a quartz plate.



2. Experimental method

(2)Measurement of surface potential after peeling

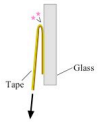


If the density of an electrical double layer produced by contact of the tape with a polymer film is sufficiently high, electrical discharge is caused by separation, so that the surface potential on the film after peeling must be restricted .

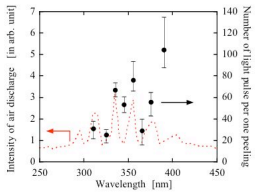
We measured the surface potential distribution on the film using an electrostatic voltmeter and X-Y movable probe.

3. Results (1)

In the case of the high-speed peeling (200mm/s), faint light could be observed by naked eye, whereas no light was detected in the case of the low-speed peeling (1mm/s).
The faint light was only emitted from a tape-air-glass triple junction.



We measured the number of detection of the light pulse per one peeling for various wavelengths.

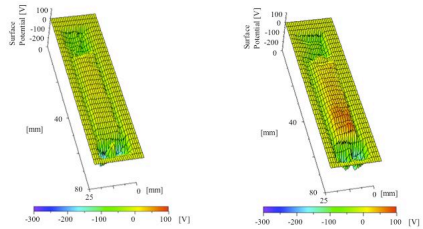


Many light pulses due to the high-speed peeling were detected at the wavelengths corresponding to the peaks of the spectrum of the air discharge light (310nm, 335nm, 355nm and 375nm).

→ The mechanism of light emission is based on the electrical discharge in air near the triple junction.

3. Results (2)

We expected that the potential on the film with the high-speed peeling became lower than that with the low-speed peeling because the electrical double layer was neutralized by the discharges

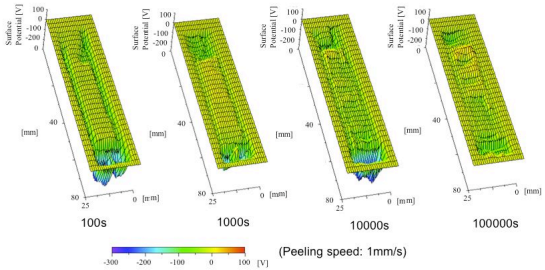


(a) Low-speed peeling (1mm/s) (b) High-speed peeling (200mm/s)

Surface potential of the film with the high-speed peeling became slightly higher than that with the low-speed peeling.

3. Results (3)

Effect of contact duration of the tape with PET-film on the formation of the electrical double layer



No increasing of the charge density with increasing the contact duration was observed.

4. Discussion and Conclusions

(1)The mechanism of light emission due to peeling is based on the electrical discharge in air near the triple junction.

(2)The discharge light did not observed under the low-speed peeling but observed under the high-speed peeling.

(3)The density of the electrical double layer at the interface is too small to induce the separation discharge.

→ Some physical reasons are required to explain the mechanism of the discharge at the triple junction.

Why did the discharge occurr under the high-speed peeling?

Why did the discharge occurr though the density of the electrical double layer was very small?