폴리이미드 및 폴리아미드막에 있어서 종류가 다른 러빙재질의 러빙에 의한 정전기 및 광학리타데이션의 평가

서 대 식, 이 창 훈
숭실대학교 공과대학 전기공학과
서울특별시 동작구 상도5동 1-1

A Study on Static Electricity and Optical Retardation with Different Rubbing Fabric films

Dae-Shik Seo, Chang-Hoon Lee
Department of Electrical Engineering, College of Engineering,
Soong Sil University, 1-1, Sangdo 5-dong, Dongjack-ku, Seoul 156-743

ABSTRACT

We have studied the static electricity and optical retardation generated by rubbing the surfaces of polyimide (PI) and polyamide (PA) films. The static electricity increases with the rubbing strength (RS) and varies with the different PI films.

We also investigated how the differences in the rubbing fabric affects the magnitude of the induced static electricity; the order of this effect is nylon > rayon > cotton. The induced static electricity is not only directly related to the values of the specific resistivity of the rubbed PI films, but also the RS and the ability of the rubbing fabric to generate and add a static electric charge.

The order of the optical retardation produced by the rubbing fabraic on rubbed PI films is nylon > rayon > cotton, coinciding with the order of the generated static electricity.

1. INTRODUCTION

Surface alignment of liquid crystals(LCs) on treated substrated surfaces is required to produce LC electro-optic devices.

Most LC displays, such as twisted nematic(TN), super twisted nematic(STN), and surface-stabilized ferroelectric LC (SSFLC), are prepared using various surface alignment techniquies : oblique evaporation of SiO films, rubbed PI films, PI Langmuir-Blodgett (LB) films, polypyrrole (PP) films, and so forth.

The rubbing method is the most widely utilized alignment technique, both in laboratories and factories, even though non-rubbing techniques have been demonstarted.

Thin Film Transistors (TFTs), used in active matrix LCDs are degraded or damaged by the induced static electricity produced during rubbing, but the detailed mechanism of the static charge generation is not clear.

In this paper, we report the static electricity generated on the surface of the rubbed PI films in conjuction with the optical retardation induced in these films. We show how the results depend on the difference of the PI films and rubbing buffs. We studied three different kinds of PI films and three different kinds of rubbing fabric.

2. EXPERIMENTAL

The PI materials and polyamide (PA) materals, studeid were:

RN-305 (PI)
:alkyl-branchless and highest polarizations;
specific resistivity is 5×10^{14} Ωcm.
RN-713 (PI)
:alkyl-branch and medium polarization;
specific resistivity is 2×10^{16} Ωcm.
HL-1110 (PA)
:alkyl-branchless and highest polarization;
specific resistivity is 2×10^{16} Ωcm.

The PI films prepared by polyimidization at 250℃ for one hour, while the PA was prepared by polyimidization at 150℃ for one hour. The PI and PA films were coated on indium-tin-oxide(ITO) coated glass substrates. The definition of the RS is reported in a previous paper.

The rubbing fabrics studied were:

Cotton: with cellulose structure, natural fiber.
Rayon: with cellulose structure, synthetic fiber.
Nylon: with polyamide structure, synthetic fiber.

After prepating the orientation film on ITO, we removed a part of the orientation film. We placed the ground electricity measuring instrument into contact with the stage of the rubbing machine. After rubbing, we immediately placed the positive electrode of the static electricity measuring instrument into contact with the ITO, and read the electrical charge[Coulomb] from the meter, We report the charge per unit area [Coulomb/m^2].

3. RESULTS AND DISCUSSION

Figure 1(a) shows the generated static charges produced using different fabrics to rub PI film (RN- 305). The static charge increases with the RS for the nylon fabric, however no substantial change is observed for the other two fabrics. Rubbing with nylon generates significantly more static charge than rubbing with rayon or cotton.

Almost the same result is obtained for RN-713 film rubbed with nylon. A small increase of static charge is generated by rayon and cotton(Fig. 1(b)).

In the case of HL-1110 as shown in Figure 1(c), nylon generates a large static charge as well. In the same fashion cotton and rayon also generate a great deal of static electricity.

We conclude, from the above results, that the largest amount of static electricity is generated with the combination of nylon buff and HL-1110. Independent characterizatio of the orientated films demonstrated that the specific resistivity of both rubbed HL-1110 and RN-713 films is high. We therefore conclude that materials with higher resistivity are capable of holding larger static electrical charges.

For rubbing fabrics, we observed that the order of the favrics ability to hold a static charge that is most easily obtained is the same as the order of their ability to generate static electricity.

We expect high resistivity fabrics to produce the most static electricity.

In this experiment. when HL-1110 (PA) was rubbed with nylon, the most static electricity is observed. We consider that it is due to the difference of the condition that one side is a buff and the characterization of the films.

In general, when the same materials rub each other, static electricity doesn't occur. But, if the tenperature increases, transformation, destruction of surface layer and the like produce difference between the material allowing the production of a charge beacause of the asymmetry.

We show the optical retardation with different kinds of rubbing fabrics on rubbed PI film (RN-713) in Figure 2.

The magnitude of the optical retardation as a function of the fabric is:

nylon = rayon > cotton

The optical retardation increase with the RS of nylon on PI film (RN-713). The optical retardation is larger with nylon than with the other two fabrics.

Nylon and rayon are synthetic fibers. The tips of these fibers are uniform and sharp, while cotton, a natural fiber, has unequel and disheveled tips.

Therefore, the static electricity is strongly correlated with the optical retardation.

We conclude that differences in the optical retardation on rubbed PI films is caused by differences in the structure of the fiber tips.

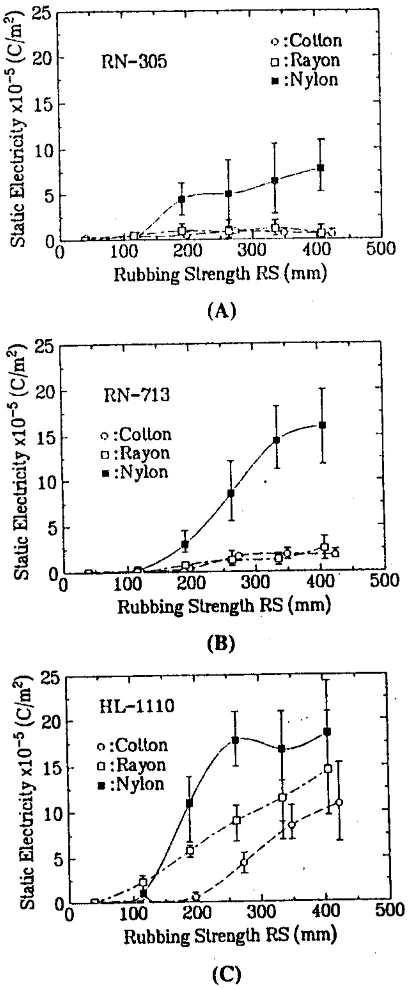

Figure 1 The generated static electricity produced using different fabrics to rub polyimide films ((A) RN-305, (B) RN-713, (C) HL-1110)

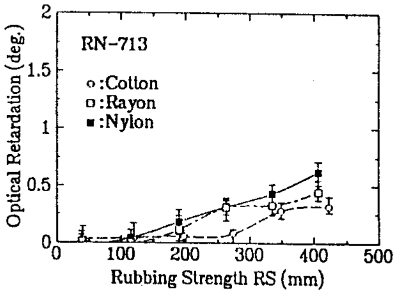

Figure 2 Optical retardation with different kinds of rubbing fabrics on rubbed polyimide films

4. CONCLUSION

We investigated the static electricity and optical retardation generated by rubbing PI and PA films with three kinds of rubbing fabrics.

The results in this work can be summarized as follows:

1) Static electicity increase with the RS with all three rubbing fabrics and rubbed PI films.
2) The order of the static electicity on rubbed PI films in this work is: nylon > rayon > cotton.
3) we conclude that the static electricity on rubbed PI films is directly related to the specific resistivity of the orientated films and ability of the fabric oth hold a charge.
4) optical retardation increase with the RS on rubbed PI films.
5) The order of the optical retardation in rubbed PI films in this work is: nylon > rayon > cotton.
6) We conclude that the static electricity is strongly correlated with the optical retardation, which is a measure of thd flow (deformation) occurring on the surfaces of substrate polymer films.

Reference

1) D.-S. Seo, S. Kobayashi and M. Nishikawa, Appl. Phys. Lett., **61**, 2394(1992).