RESEARCH OF POLYESTER FILM FOR ELECTRONIC COMPONENTS

I. Gorišek[(1)], K. Požun[(2)], L. Koller[(2)], S. Gramc[(1)]
(1) HIPOT- P&EMS, Šentjernej, (2) IEVT, Ljubljana

Keywords: passive electronic components, PCB, Printed Circuit Boards, polyester films, polymeric polyester, electrical potentiometers, surface treating, UV irradiation, surface energy increasing, promotion of adhesion, resistive paste deposition, quality control.

Abstract. Polyester film is frequently used material in electrical industry. It is used as dielectric and as substrate for different printed circuits. Poor adhesion and low surface energy are the most significant properties of polyester film.

Different methods of surface treatment of polyester were used to achieve promotion adhesion for applying polymer resistive paste for potentiometers. Methods of surface treatment with UV and control method were developed.

Raziskava lastnosti poliester traku za podlago elektronskih komponent

Ključne besede: deli sestavni elektronski pasivni, PCB plošče vezja tiskanega, plasti poliesterske, polimer poliester, potenciometri električni, obdelava površinska, UV obsevanje ultravijolično, povečanje energije površinske, povečanje adhezije, nanosi past uporovnih, kontrola kakovosti.

Povzetek: V proizvodnji pasivnih elektronskih komponent in tiskanih vezij, se za podlage teh elementov vedno pogosteje uporablja polimer poliester. Dobri lastnosti poliestra sta nizek odstotek vsebnosti vlage in majhna površinska energija, ki pa jo lahko z ustrezno obdelavo povečamo do potrebne veličine.

V svetu so znane različne metode za površinsko obdelavo poliestrskih trakov za doseganje dobre adhezije, oziroma povečanje površinske energije na osnovni plasti, ki je potrebna za nanos polimerne uporovne paste za potenciometre. Predstavljamo metodo obdelave površine poliester traku z UV žarki, ki z ustrezno kontrolo omogoča izdelavo kvalitetnih potenciometrov.

1. INTRODUCTION

Polyester film based on polyethylene terephthalate is widely used in electrical industry as dielectric and as a substrate for printed circuits. There are some reasons, why polyester is so often specified for this and many other applications. Film combines exceptional strength and durability with good dimensional stability, has low water absorption capacity and is resistive to attacks of many chemicals, especially oils and solvents used in the electrical industry. The absence from plasticizers makes film highly acceptable for deposited coatings and ensures negligible outgassing during processing.

In this paper we will introduce the use of polyester film in production of potentiometers. Instead of standard phenolic paper we have used polyester film as a substrate, especially for its low water absorption capacity and its absence of plasticizers.

Significant properties of polyester films are their low surface energy, poor wettability and adhesions to polymers.

The surface energy of a solid substrate affects directly no matter how well a liquid wets the surface.

Different surface treatment methods can improve wettability of the materials by increasing the material's surface energy, and adhesive characteristics are positively affected by creating bonding sites.

Some methods of surface treatment are:

- Corona discharge treatment:
  - Corona discharge treatment is based on high voltage, high frequency discharge in air. The sample passes through the discharge region between two electrodes.
- Thrichloroacetic acid (TCA) treatment:
  - 5 to 10% solution of acid in tholuene or water is used. After application the TCA must be heated for approximately one minute at 80 °C to 120 °C to remove the solvent.
- UV treatment:
  - The sample is exposed to UV lamp.

2. EXPERIMENTAL

Two different methods of polyester films treatment were compared. The first half of polyester strips was exposed to corona discharge and the second half of strips was irradiated with the UV IST- lamp with energy of 3.0 kW.

The UV lamp treatment system was developed by P&EMS. Various exposure times of corona discharge and UV lamp were tried.

The adhesion of polyester was tested with ICI pencil (test method of polyester film producer). On the polyester strip we painted the 3x3 cm square and we observed disappearing of the colour. If the colour remains

on the surface, the treatment to improve adhesion is successful.

The treated strip was deposited with polymer resistive paste of potentiometer. The box, which we used to deposit polymer resistive paste was layed on the treated polyester strip. A polymer resistive paste was applied on the strip by moving the box on the strip.

A deposited strip was dried for 30 minutes in dry chamber at temperature of 160 °C. A dry polyester strip was punched to get potentiometers resistive plates. The obtained resistive plates were used to compose potentiometers.

Potentiometers' humidity test was done to examine the low water absorption of polyester film. The test was done at the temperature of 40 °C. The relative humidity was 93 %. The resistance change was obtained from the measurements of the potentiometer resistance at the beginning and at the end of the test.

3. RESULTS AND DISCUSSION

In Table 1 the duration of treatment of polyester film and adhesion after treatment for two different treatments are shown.

Table 1: Time of treatment and achieved adhesion

Method of treatment	time of treatment [s]	adhesion
corona	7	good
	15	good
	60	good
UV lamp	12	good
	15	good
	18	good

The corona discharge treatment gives a satisfactory adhesion after 7, 15 and 60 seconds but this treatment has also a disadvantage. The coating of polymer resistive paste must follow immediately because the corona discharge treatment quickly loses its effectiveness with time.

The treatment with UV lamp also showed good adhesion after 12, 15 and 18 seconds of irradiation. UV-

Table 2: Humidity test of polyester film

Nominal resistance is 50 kΩ

Number of sample	resistance before test [%]	resistance after test [%]	change of resistance [%]
1	-8.83	-9.19	-0.26
2	-7.58	-6.15	1.43
3	-13.89	-13.39	0.50
4	-1.97	-0.95	1.02
5	-6.15	-5.48	0.67
6	-9.61	-8.73	0.88

Table 3: Humidity test of phenolic paper laminate

Nominal resistance is 50 kΩ

Number of sample	resistance before test [%]	resistance after test [%]	change of resistance [%]
1	2.7	6.4	3.7
2	10.5	14.4	3.9
3	6.0	10.4	4.4
4	1.9	5.8	3.9
5	1.5	1.9	0.4
6	-7.7	-4.7	3.0

treated polyester strips may be stored up to three months without losing the effectiveness.

In Tables 2 and 3 the humidity test of potentiometers made by polyester film and phenolic paper laminate is presented.

The variation of resistance is greater in potentiometers made of phenolic paper laminate. The resistance measurements are given as percents of the nominal resistance of potentiometer which is 50 kΩ. The results indicate that the substrate used strongly influences the change of the resistance in wet heat. That fact proves the resistance of polyester to the water vapour absorption.

4. CONCLUSION

The results of our investigation show that polyester films can be used as a substrate of potentiometers instead of phenolic paper laminate. For potentiometer production the UV treatment is simple and suitable method to achieve promotion adhesion for applying polymer resistive paste, because the treated polyester films may be stored up to three months, before effects of treatment are lost.

REFERENCES

/1/ Polyester film, Industry note MX 206 sixth edition, Conversion and fabrication, Imperial Chemical Industries PLC

/2/ TANTEC, The-On Line 3-D Surface Treatment Technology, leaflet 1996

/3/ J.E.E. BAGLIN, Interface tailoring for adhesion using ion beams, *POLYMERS*, 8, 1989, 764-768

Ida Gorišek, dipl. ing., Slavko Gramc, dipl. ing.
HIPOT-P&EMS
Trubarjeva 7, 8310 Šentjernej, Slovenija
Tel.: +386 68 81 220
Fax: + 386 68 81 370

Karol Požun, dipl. ing., Lidija Koller, dipl. ing.
IEVT
Teslova 30, 1111 Ljubljana, Slovenija
Tel.: +386 61 177 66 66
Fax: +386 61 126 45 78

Prispelo (Arrived): 02.02.1997 *Sprejeto (Accepted): 25.02.1997*