Anti-static coating solution for flat panel dispiay

Product Development Room, Advanced Materials Business Division

1. Introduction

Plastics is easy to work, lightweight, and rust resistant. It is also prone to static electricity that collects dust and is scratched easily. Since a scratch on the surface of acrylic or other transparent resins drastically lowers their cosmetic value, products made of these resins are usually protected by a hard coat. These drawbacks are the reason behind the growing need for antistatic materials that help maintain the surface of plastic products in a dust-free condition at all times.

Introduced below is an antistatic solution of hard coatability coated on the front acrylic panel of the projection TV and other flat panel displays. The properties of the coat are also provided.

2. Hard Coating and Antistatic Technologies

Hard coat can be applied by several techniques including the direct coating, transfer of a set film, and laminating. The first technique (direct coating) is divided into three types; (a) deposition processes such as vacuum evaporation and sputtering, (b) thermosetting process in which silicone, melamine, urethane, or other coating solution is applied and cured, and (c) setting by UV radiation, electron radiation, etc. Among them, the UV radiation setting is used most often because of its higher productivity, surface hardness, and durability.

Static electricity can be prevented by one of two methods; (a) ion conduction in which an electric current is created when the particle dissociated as ions by airborne moisture move inside or the surface of a substance, and (b) electron conduction. The ion conduction method is subject to moisture and other environmental conditions, which makes it hard to prevent static electricity with stability. The electron conduction method is nearly free from environmental conditions and provides stable preventive performance.

Conductive oxides belong to the electron conduction method in which an electric current is generated by the motion of electrons or halls caused by defects in a crystal structure. The electric path is created by the contact between the conductive oxides including tin oxides, antimony tin oxides (ATO), zinc oxides, antimony oxides, indium tin oxides (ITO), etc. Among them, antimony tin oxides (ATO) are used the most often for preventing static electricity.

The antistatic solution for flat panel displays, developed by our company, is a one-pack product that offers both hard coatability and prevention of static electricity.

3. Product Features and Solution Specifications

Our antistatic solution for flat panel displays consists of the proprietary ultrafine ATO particles that are dispersed in UV-setting resins. It is used to produce an antistatic, hard coat of high transparency and low haze.

The solution is made to the following specifications:

Appearance : Dark bluish violet color
Solid content : 30%
Resin : UV-setting resin
Specific gravity : 0.93
Viscosity : 1.6cP
Main solvent : Ketone solvent

4. Properties of Coat

Table 1 shows typical characteristics of an antistatic hard acrylic panel on which our antistatic solution is applied. Its total light transmittance of 92% and haze of 0.4% make it as clear as the uncoated acrylic panel.

The surface resistance of the antistatic coat is 10^9 ~ $10^{10}\Omega/\square$, and the electric charges are discharged instantly when 10kV is applied by a static honest meter. This endorses the solution's excellent antistatic performance.

The hard coatability is indicated by the pencil hardness number of 5H. The coat withstands marring tests by steel wool.

Table 2 shows the result of a chemical resistance test

using a 50μm PET substrate. There was virtually no difference before and after the samples were dipped in boiling water, ethanol, acetone, and toluene, respectively.

Figure 1 shows the result of a weather resistance test (change in surface resistance by the number of hours of UV radiation). The hard coat showed excellent resistance against UV radiation with virtually no change in the total light transmittance over 600 hours on the fade-meter (UV carbon arc weather resistance test) and with only a slight decrease in the surface resistance. The test result endorses that both necessary transparency and antistatic performance are maintained.

5. Concluding Remarks

Coating materials for the flat display panels are subject to unconventional requirements for high transparency, low haze, and antistatic hard coatability. This is considered a functional enhancement of the conventional acrylic hard coat. The conflicting demands for transparency and antistatic performance are expected to keep growing through the future. Since an antistatic hard coat can eliminate two major drawbacks of transparent panels, namely the tendencies to be scratched and to collect dust, the range of application for the antistatic hard coating materials is most likely to expand in the future.

In addition to the antistatic solution for flat display panels introduced above, our coating materials for plastics are also available with the surface resistance adjusted to $10^7 \sim 10^{10}\Omega/\square$ and applicable on PET, polycarbonate, and other substrates. Our solutions are also compatible with additional treatment to prevent optical reflection (AR) or glare (by roughing treatment) on various substrates and for a wide range of applications.

Table 1 Characteristics of antistatic acrylic coat

Total Light Transmittance	／ %	92
Haze	／ %	0.4
Adhesion (cross cut)		100／100
Tensile strength	／ MPa	68.6
Elongation	／ %	3.0
Bending strength	／ MPa	88.3
Modulus of elasticity	／ MPa	3138
Taber abrasion test		
100 cycles △Haze	／ %	3.0
500 cycles △Haze	／ %	12.0
Steelwool scratching test		A
Pencil hardness		5H
Surface resistance	／ $\Omega\cdot\square^{-1}$	$10^9 \sim 10^{10}$

Table 2 Chemical resistance of antistatic hard film

	Boiling Water	Ethanol	Acetone	Toluene
R (before) ／ $\times 10^{10}$ $\Omega\cdot\square^{-1}$	1.7	2.6	3.1	3.9
R (after) ／ $\times 10^{10}$ $\Omega\cdot\square^{-1}$	1.9	2.8	3.1	3.7
R (after) ／ R (before)	1.12	1.08	1.00	0.95

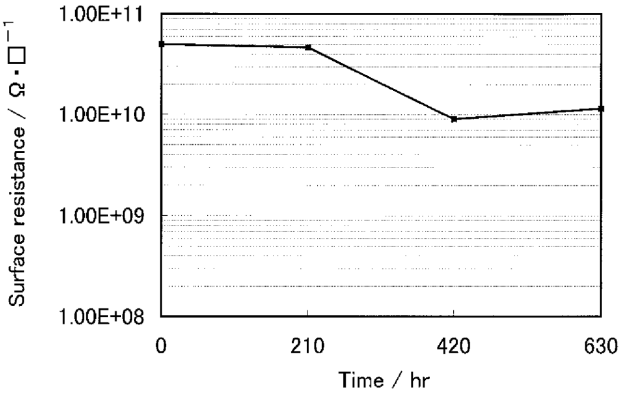

Fig. 1 Weather resistance of antistatic film