Orgacon™ - The Organic alternative to ITO

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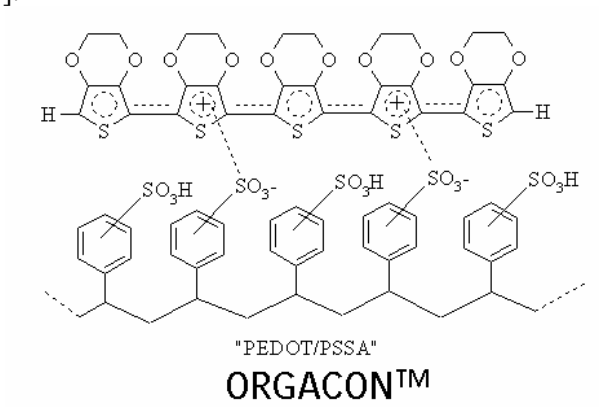
Abstract

Orgacon™ products, based on the conducting polymer PEDOT/PSS, are very promising materials in cost-effective R2R production of large area electronics. This presentation will show both the progress in the surface resistance/VLT and progress in the stability (T/R.H. and light stability). A new generation of films, coating formulations and inks will be presented

1. Introduction

Agfa Materials has a leading position in producing film and related products at low cost for the graphical and healthcare industry. ORGACON™ Electronic Materials is part of the Electronic Consumables Business Group of Agfa-Materials.

Our products are based on PEDOT/PSS conductive polymers which were developed in the early 90-ties and have already been used for more than 15 years in the antistatic layers of photographic films [1]. Since then, more conductive and more transparent variants of this remarkably environmentally stable conductive polymer have been developed and are being produced [2].



ORGACON™ combines a high light transparency comparable at practically useful surface resistance levels to sputtered ITO together with high flexibility and formability. This combination of properties cannot be matched by any other organic or inorganic transparent conductive coating.

These exceptional properties enable a myriad of new device applications to be realized which were previously not possible. As electronic devices become more and more wireless, wearability (flexibility) and integration into the shape or design of common objects (formability) are key properties that can only be provided by the ORGACON™ concept.

Our base product (water based dispersion) can be used as such in coating formulations or converted into (high boiling) solvent-based products such as screen printing inks or even into low boiling point solvents leading to general applicability to and compatibility with most coating and printing technologies.

This paper shows the most recent progress in the further improvement of surface resistance/VLT combined with excellent environmental stability.

2. Results

Key features of PEDOT/PSS are flexibility and processability. Flexibility gives more robustness to the end application: commercial examples are the replacement of ITO in flexible EL keypad lighting for the slim mobile phones or the replacement for ITO in resistive touchscreen allowing an increased number of touches.

Processability is important in the production process of end applications. PEDOT-based ink jet-, screen-, flexography- or gravure inks ensure a fast printing process combined with curing at low temperature. This allows the use of cheap plastic supports or even paper. For large area application slot die- or microgravure coating provide very uniform layers at high speed.

However the key property to being successful in display application is the ratio between the surface

resistance and visual light transmission (SER/VLT). Figure 1 shows the evolution of SER/VLT for different generations of PEDOT/PSS from Agfa. Compared to the first generation (Gen 1) for antistatic applications, the SER/VLT improved 2.5 times for the most recent PEDOT/PSS developments (Gen 3). Both Gen 2 and Gen 3 materials are acceptable in display applications, e.g. resistive touchscreen or e-paper electrodes. Key parameters for this improvement is the selection of PSSA, poly(styrene sulphonic acid) and the optimization of polymerization conditions. In particular side reactions, such as the oxidation of the thiophene unit or chain terminations, must be prevented.

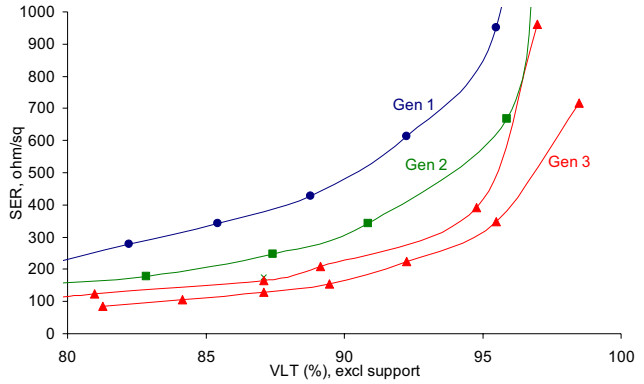


Fig. 1. Surface Resistance (Omh/sq) vs Visual Light Transmission (%) for 3 generations of Agfa's PEDOT/PSS.

Figure 2 shows the comparison of the VLT vs wavelength for PET coated with PEDOT or sputtered with ITO. For all wavelengths the VLT is superior. The newest development, Orgacon_300New, exhibits a lower SER and higher VLT compared to the previous Orgacon EL350.

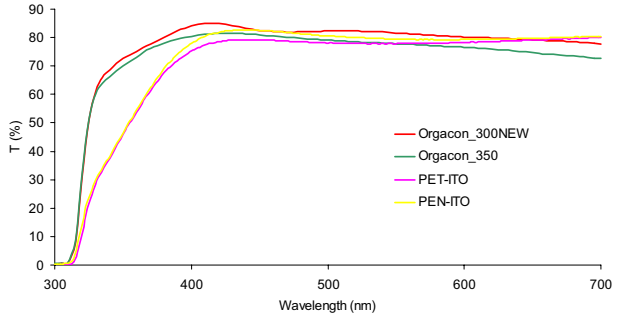


Fig. 2. Transmission (%) vs wavelength for Orgacon Film compared to ITO (PET-ITO = 180µm - 60 Ohm/sq; PEN-ITO = 120µm – 60 Ohm/sq; Agfa-PET = 120µm).

Another key feature for these transparent electrodes is their overall stability, which is commonly believed to be inferior for PEDOT/PSS based products compared to TCO materials. A detailed study[3],[4] of the degradation mechanism of PEDOT/PSS based coatings points to chain scission and de-sulphonation of PSS, combined with the oxidation of the S in the thiophene unit to sulfoxide/sulphone as root causes for the increase in SER with time. Figure 2 shows that a combination of two clasess of compounds unexpectedly leads to Orgacon™ products with good starting SER properties and excellent stability both in high T/high RH (60°C/95%R.H.) and in Suntest (WG-filter – indoor; Irradiance 71.7 W/m2 = 71.7 J/s.m2; Black panel T = 50°C) conditions.

3. Summary

PEDOT/PSS based products already have shown their benefits in lots of commercial applications. The recent improvements in SER/VLT and stability, combined with the flexibility and processability open the window to low cost, R2R, large area electronics. The combination of all these properties cannot be met by any currently available.

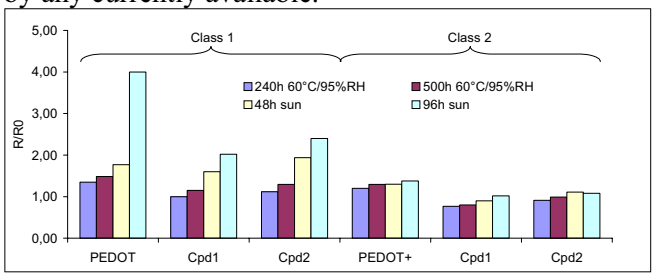


Fig. 3. Surface Resistance Increase (R/R0) for improved formulations after different stability tests).

4. References

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