

CHASM Ag^eNT™-10

Hybrid Transparent Conductive Films



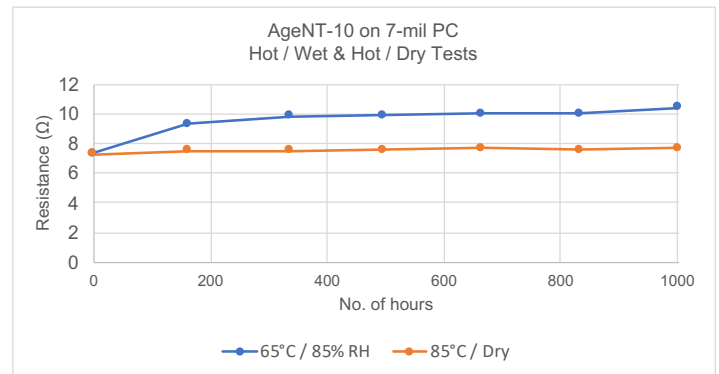
PRODUCT DESCRIPTION

Ag^eNT-10 is a CNT Hybrid Transparent Conductive Film (TCF) made by printing Carbon Nanotube (CNT) ink onto Silver Nanowire (AgNW) film to create a flexible TCF that is substantially better than either CNTs (more conductive) or AgNWs (more robust and lower cost patterning).

HOW AGENT™ WORKS

CNT ink is formulated for screen printing and is comprised of a mixture of our singlewalled CNTs (CoMoCAT™ technology), an optically clear polymer binder and our proprietary ink vehicle (V2V™ technology). The grade of CNT ink that is used for making Ag^eNT-10 product structures is CHASM-AGENT-VC201. CNT ink is available in standard 1L bottles. AgNW film is made by coating AgNWs to random network of AgNWs on a continuous roll of clear plastic film substrate. AgNW layer is ~ 0.7µm thick. There is one substrate option for Ag^eNT-10: 7-mil PC film without hard coat (HC) on the backside. The grade of AgNW film that is used for making Ag^eNT-10 product structures is CHASM-AGENT-AW121. AgNW film is available in standard sheet size up to 457mm X 605mm and can also be provided in approx. 605mm or 1,210mm wide rolls.

ENVIRONMENTAL



Resistance, adhesion and optical properties exhibit very stable behavior with environmental aging.

OPTOELECTRONIC PROPERTIES

	TCF + Substrate	TCF only
Sheet Resistance (Ω/\square)	10	10
VLT (%)	83.0%	90.9%
Haze (%)	3.7%	3.3%
L*	92.00	-
a*	-1.97	-
b*	4.57	-

Optical properties measured by R-chek 4-point resistance meter, BYK Haze-gard transparency meter or X-Rite spectrophotometer

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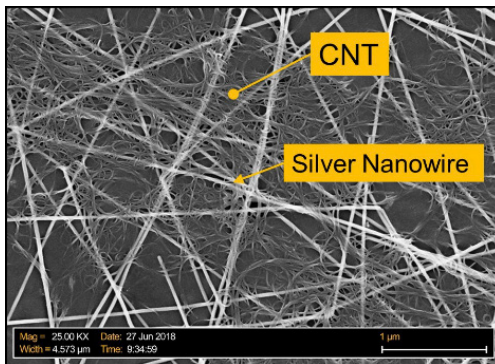
Hybrid Transparent Conductive Films



AGENT-10 STACK

PE Release Liner
10 Ω/\square AgNW coating
7 mil PC Film
PE Release Liner

AW121



PRODUCT BENEFITS

- Low sheet resistance with extremely high optical transparency
- Low materials and processing costs for creating patterned TCFs
- Can be flexed or formed for flexible, wearable, or 3D products
- Resistance, adhesion and optical properties are very stable with environmental aging.

TARGET APPLICATIONS

- Transparent Heaters
- RF / EMI Shielding
- Transparent Electrodes for Lighting
- Transparent Wiring for LEDs

FABRICATION PROCESS

Flexible printed circuit (FPC) patterns are created by:

1. screen printing CNT ink on top of the AgNW film
2. hot air drying at $\sim 100^\circ\text{C}$;
3. chemically etching the exposed AgNW areas

Typical etchant is Ferric Nitrate (industry standard for etching Silver). This affordable circuit patterning process is suitable for mass production and is referred to as "Print / Etch / Done". It has fewer steps & less waste streams than photolithographic etching, and is much faster than laser ablation. The CNT ink is a multi-functional material that acts as a printed etch mask (for low-cost patterning) and also encapsulates the AgNWs (to create a more robust TCF).

AgeNT-10: 10 Ω/\square at 90% VLT

DISCLAIMER

The information provided in this Technical Data Sheet (TDS) including the recommendations for use and application of the product are based on CHASM's accumulated experience as of the date of publication. Product performance will vary based on application and operational environment, so CHASM Advanced Materials Inc. is not liable for the suitability of our product for the intended applications and results.

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