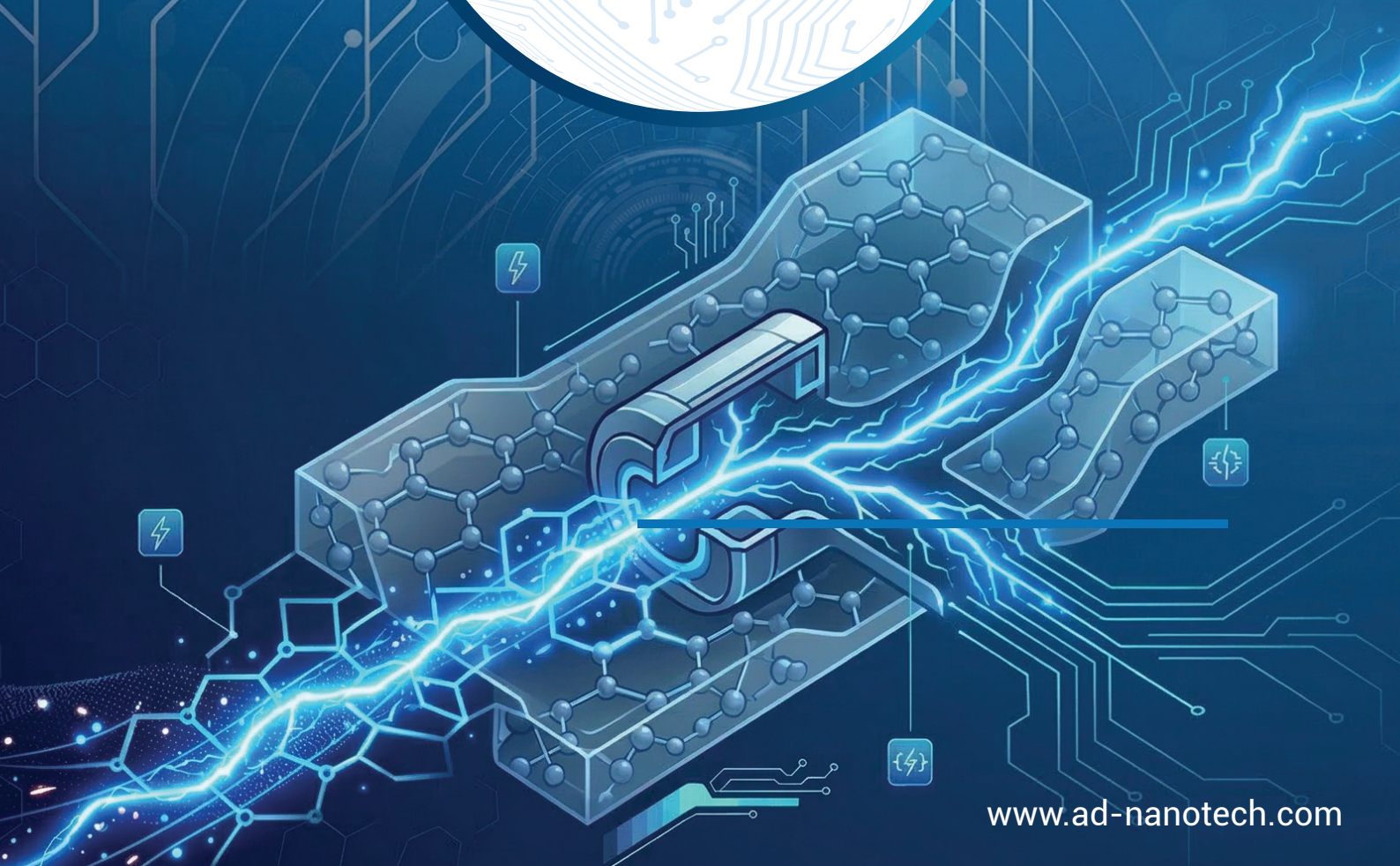
adnano® Technologies

ADCNT-PP MB

ELECTRICALLY CONDUCTIVE CARBON NANOTUBES-PP MASTERBATCH



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Electrically Conductive Carbon Nanotubes - PP Masterbatch

1. Product identification

- Product name: ADCNT-PP MB
- Polymer matrix: Polypropylene (PP)
- Conductive additive: Customized carbon nanotubes (CNT)
- Carbon nanotube loading: **15% ± 1 wt%**
- Physical form: Black pellets

2. Product description

ADCNT-PP MB is a highly filled conductive masterbatch based on polypropylene containing 15% Customized carbon nanotubes. It is designed to impart permanent ESD and electrical conductivity to PP compounds at relatively low CNT loadings, enabling a broad range from insulation to highly conductive behavior by adjusting the dilution level in PP.

3. Typical properties (masterbatch)

Property	Test method	Value
Color	Visual	Black
Occurrence	Visual	Black pellets
CNT loading	–	15% ± 1 wt%
Real density	ISO 1183	556 g/L
MFI (230 °C / 2.16 kg)	ASTM D1238	Not measurable (very low flow)

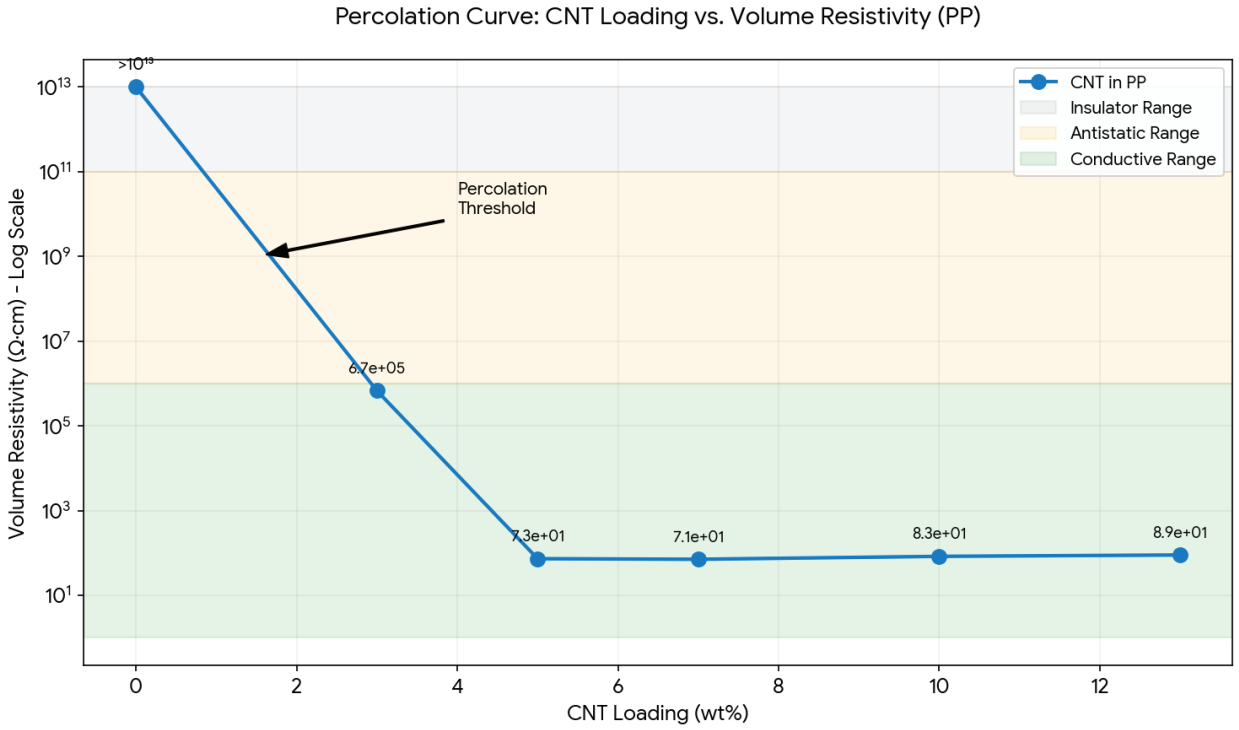
4. Electrical properties after dilution in PP

4.1 Appearance and flow after dilution of 15% MB to wt.% of CNT.

Property	Test method	Neat PP	3% CNT	5% CNT	7% CNT	10% CNT	13% CNT
Color	Visual	White	Black	Black	Black	Black	Black
Occurrence	Visual	White pellets	Black pellets	Black pellets	Black pellets	Black pellets	Black pellets
MFI (230 °C / 2.16 kg, g/10 min)	ASTM D1238	65	~27	~13	~6	~3	NM

4.2 Volume resistivity vs CNT loading (percolation)

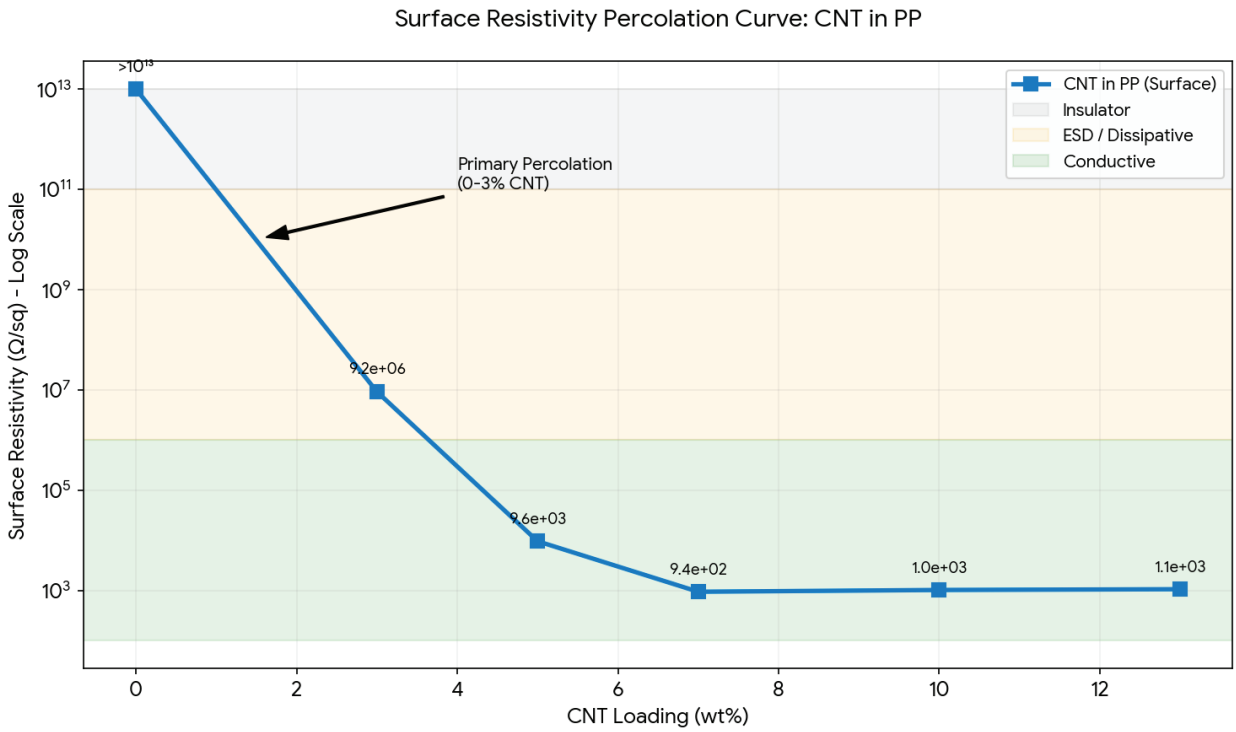
CNT in PP (wt%)	Volume resistivity (Ω·cm)
0	$>10^{13}$ Ω·cm
3%	6.74×10^{5} Ω·cm
5%	7.30×10^{1} Ω·cm
7%	7.07×10^{1} Ω·cm
10%	8.29×10^{1} Ω·cm
13%	8.92×10^{1} Ω·cm



- **Network Formation:** CNTs establish a conductive "spider-web" path at just **0.5–3% loading**, whereas Carbon Black requires a "clunky" 15–20% dosage to work.
- **Massive Jump:** Resistivity drops by over **7 orders of magnitude** at 3% CNT, instantly transforming an insulator into a dissipative material.
- **The "Sweet Spot":** At 5% loading, the system hits peak conductivity (10 Ω.cm), offering the best balance of electrical performance and material cost.
- **Diminishing Returns:** Increasing loading from **5% to 13%** provides almost no extra conductivity but significantly increases melt viscosity and part weight.
- **Efficiency Leader:** In PP, CNTs reach high-conductive ranges with **10x less** material than Carbon Black, preserving the polymer's original toughness and flow.

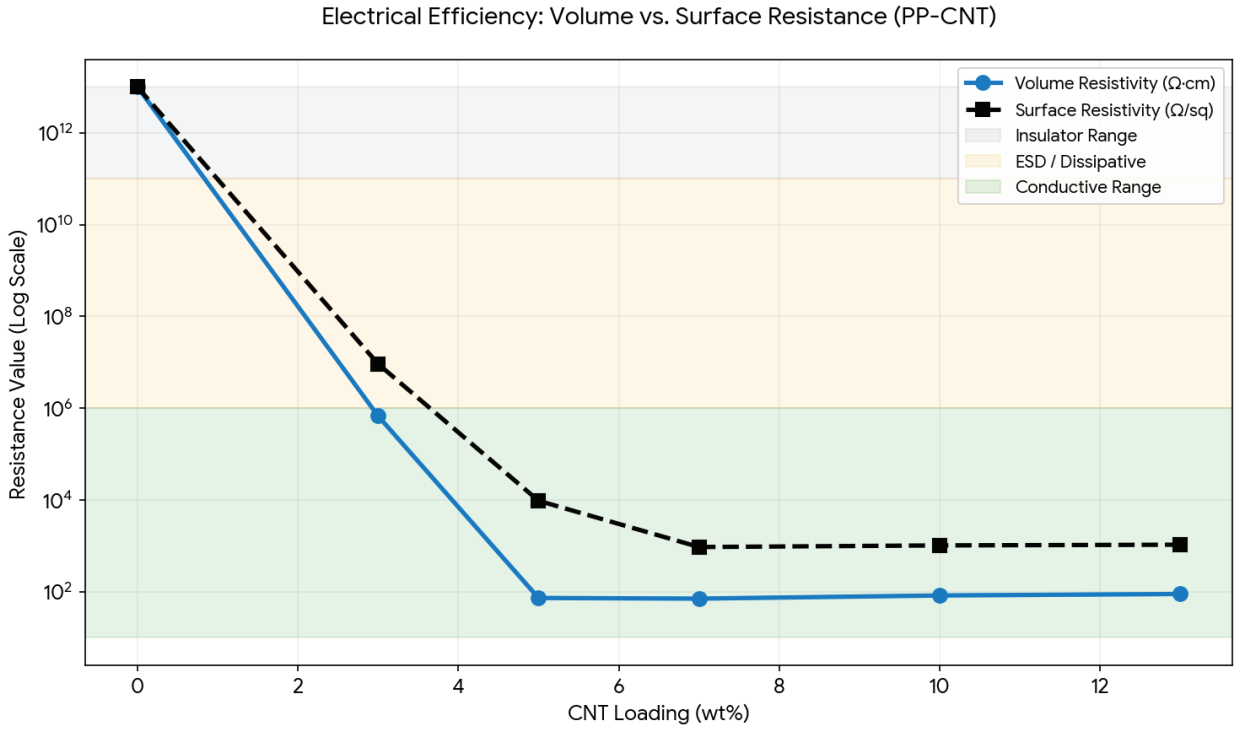
4.3 Surface resistivity vs CNT loading (percolation)

CNT in PP (wt%)	Surface resistivity (Ω/sq)	~ Surface Resistivity band (Ω/sq)
0	>10^{13} Ω/sq	Insulator
3	9.20 × 10^{6} Ω/sq	~10^{7} Ω/sq
5	9.58 × 10^{3} Ω/sq	~10^{4} Ω/sq
7	9.42 × 10^{2} Ω/sq	~10^{3} Ω/sq
10	10.21 × 10^{2} Ω/sq	~10^{3} Ω/sq
13	10.582 × 10^{2} Ω/sq	~10^{3} Ω/sq



- **Surface Activation:** Surface resistivity drops from an insulator (>10^13 ohm/sq) to the ESD band (10^7 ohm/sq) at just 3% CNT loading.
- **Conductive Threshold:** At 5% loading, the surface hits the conductive range (10^4 ohm/sq), providing a high-performance network for grounding applications.

- **Network Saturation:** Beyond 7% loading, the surface reaches a plateau (10^2 to 10^3 ohm/sq), where adding more CNT provides no significant electrical gain.
- **Peak Efficiency:** The most cost-effective sweet spot for surface conductivity is 5% to 7% CNT, after which you encounter diminishing returns.
- **Superior Coverage:** Unlike Carbon Black, the high-aspect-ratio CNTs create a dense surface web that remains conductive even at very low concentrations.



5. Recommended applications (PP + CNT)

CNT in PP (wt%)	Surface resistivity band (Ω/sq)	Typical PP applications
~3%	~10^7 Ω/sq	ESD trays, bins, pallets, antistatic housings.
~5%	~10^4 Ω/sq	Conductive ESD fixtures, jigs, carriers.
7–10%	~10^3 Ω/sq	EMI-assist housings, conductive components.
10-15%	<10^3 Ω/sq	Highly conductive parts, grounding components.

6. Processing guidelines (PP + CNT MB)

- **Drying:**
  - PP is usually processed undried, but dry MB and PP if the moisture >0.1–0.2% (e.g.80–90 °C, 2–3 h) for stable MFI and SR.
- **Processing temperature:**
  - Melt temperature: **200–250 °C** depending on PP grade.
  - Use standard PP injections or extrusion profiles, adjusting for higher viscosity at high CNT loadings.
- **Shear and mix:**
  - Use moderate screw speed; avoid excessive shear peaks that can shorten CNTs and slightly reduce conductivity.
  - Ensure good premixing of MB and base PP (tumbler or gravimetric dosing) to avoid streaks and local insulating regions.

7. Storage and handling

- Store ADCNT– PP MB in closed bags in a cool, dry place, away from direct sunlight.
- Re-seal open bags and, if necessary, re-dry before use.
- Minimize dust; follow CNT-related SDS for PPE and handling.

8. Required Masterbatch loading to achieve target CNT wt% in final PP

CNT concentration in Masterbatch: 15 ± 1 wt% in PP.

MB Loading = (Target CNT in final polymer / CNT concentration in Masterbatch)*100

Target Surface Resistivity band	Target CNT wt% in final PP	Required CNT-PP MB (wt%) loading in PP
~10^7 Ω/sq (ESD)	3%	~ 20% MB
~10^4 Ω/sq (conductive)	5%	~ 33% MB
~10^3 Ω/sq (conductive / EMI-assist)	7%	~ 47% MB
<10^3 Ω/sq (Highly conductive)	~10%	~ 67% MB

Disclaimer

The values are typical and are for very general guidance and must not be used as a basis for specifications as concrete. Information contained in this publication, and otherwise supplied to users, is based on our general experience and is given in good faith, but we are unable to accept responsibility in respect of factors which are outside our knowledge or control. No warranty, either expressed or implied, is hereby made. The recommended industrial hygiene and safe handling procedures are believed to be generally applicable. Please refer to MSDS of respective products for safe use.

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