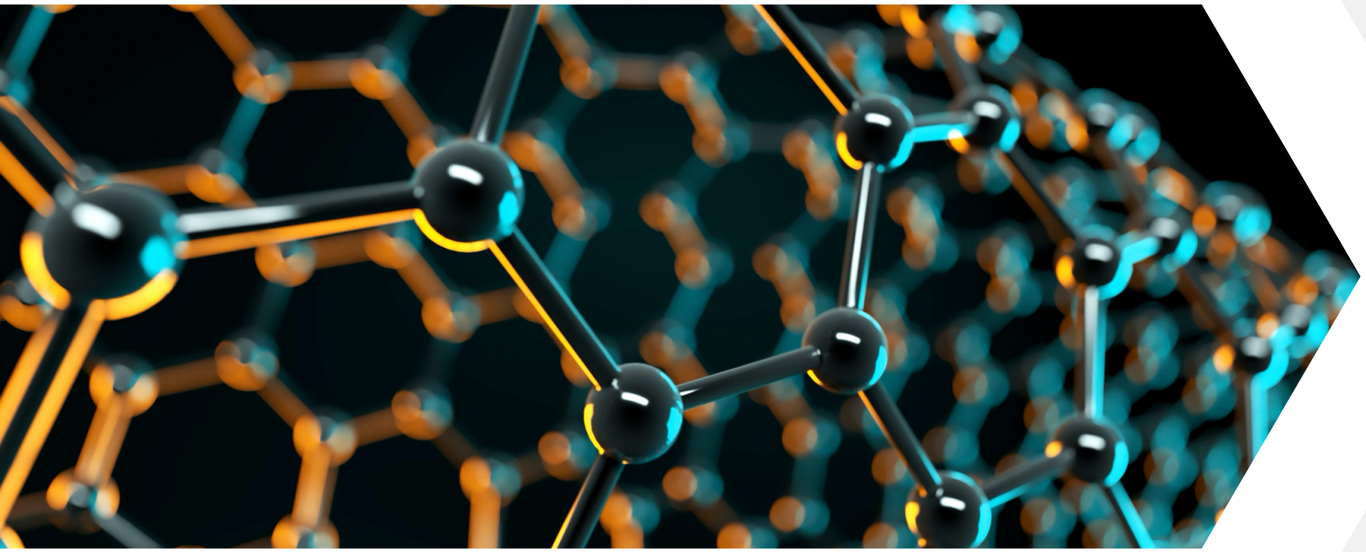
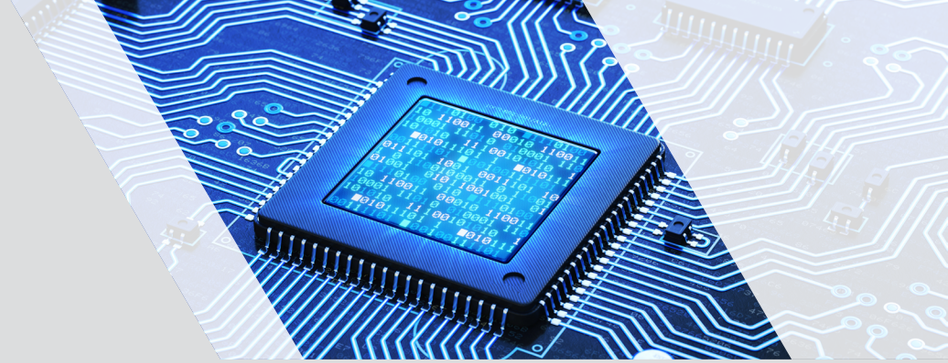
CABOT

PRODUCT GUIDE

ATHLOS™ CNS PLASTICS





Introduction

Cabot Corporation has a long history as a leader in conductive carbon additives; we have collaborated with our customers for over 135 years to drive innovation forward and solve performance challenges. The global trend of electrification across multiple industries and markets requires products to be lighter, smaller, thinner and more conductive without sacrificing strength. ATHLOS™ carbon nanostructures (CNS), Cabot's latest conductive carbon solution, deliver an exceptional combination of conductivity, purity, electromagnetic interference (EMI) shielding and mechanical strength for plastic applications.

INCLUDED IN THIS GUIDE

Benefits of ATHLOS™ CNS in Plastics

Increasing trends in electrification have created a demand for greater connectivity, reliability and compliance with tight safety regulations requiring advanced conductivity, mechanical integrity and EMI shielding.

Transportation applications such as electronic control units, cameras, radar, light detection and other sensors all need dependable performance over time. Battery and thermal management systems are increasingly requiring sophisticated design, which call for complex formulations. Utilizing CNS in these applications enables formulators the ability to meet their conductive and mechanical requirements while reserving more space for other additives.

In the semiconductor packaging space, purity specifications continue to become more stringent with metal and ion content requirements tightening. While in communication, 5G base stations and wireless connections need greater data transfers at faster speeds that are challenged by electromagnetic compatibility (EMC).

CNS enables plastics to deliver optimal conductive and EMI shielding performance in next generation products. ATHLOS CNS facilitates several key performance features including:

- High electrical conductivity
- Low electrical percolation threshold
- High EMI shielding performance
- Reinforcement
- Light-Weighting
- Recyclability
- Purity
- Formulation flexibility
- Synergy with conductive/ nonconductive fillers

ATHLOS™ CNS Electrical Conductivity Performance

ATHLOS™ CNS significantly enhances the electrical conductivity of plastic compounds at low loading levels. The electrical percolation thresholds of ATHLOS CNS are between 0.25% and 0.5% by weight in various plastic systems. The percolation threshold of ATHLOS CNS is significantly lower than typical conductive additives for plastics, e.g., carbon blacks (CB), carbon fibers, and multi-walled carbon nanotubes (MWCNT).

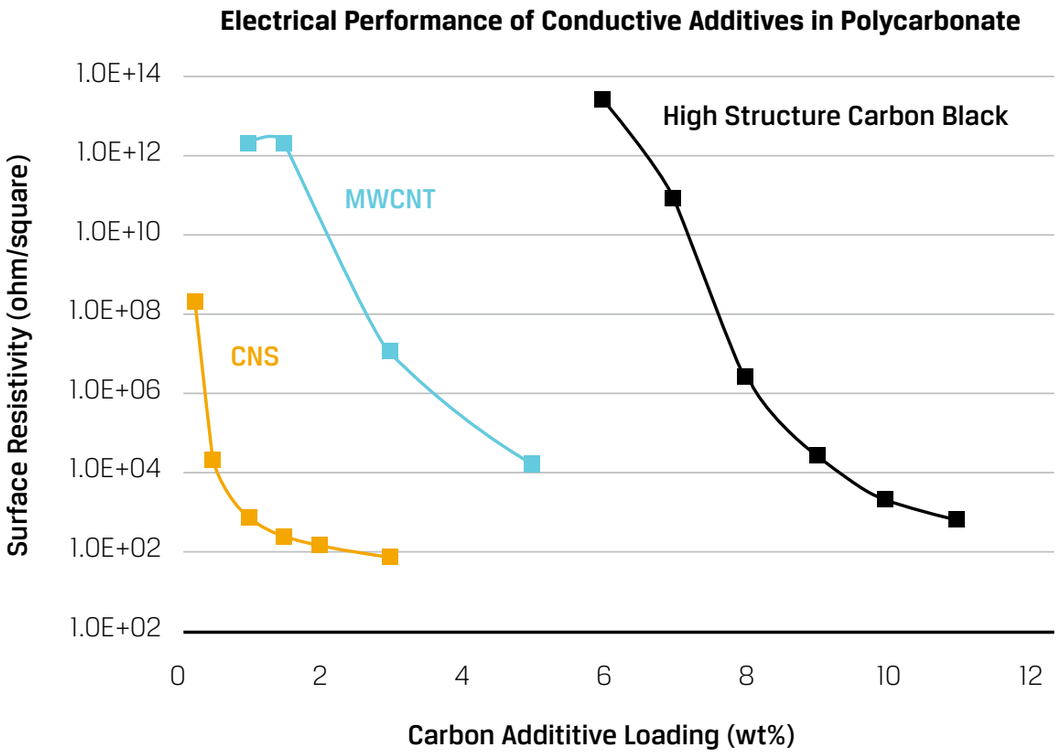


Figure 1: Electrical percolation of CNS, MWCNT and a carbon black in polycarbonate.

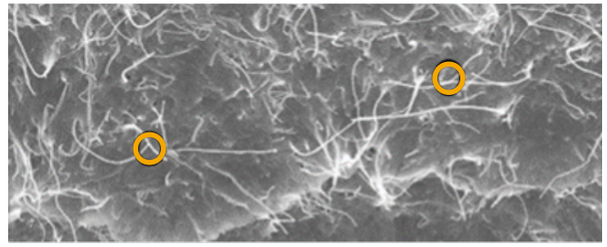


Figure 2: An SEM image showing excellent dispersion and branching morphology (as highlighted by orange circles) of CNS in a polycarbonate (PC) compound.

Mechanical Properties

Due to its low percolation threshold, ATHLOS CNS enables an optimal balance of conductivity and mechanical properties.

The unique structure of CNS enables highly differentiated reinforcement vs. other conductive carbon additives. As the market for conductive plastics shifts to smaller, lighter, and thinner parts, the need for high strength plastic compounds is becoming increasingly critical.

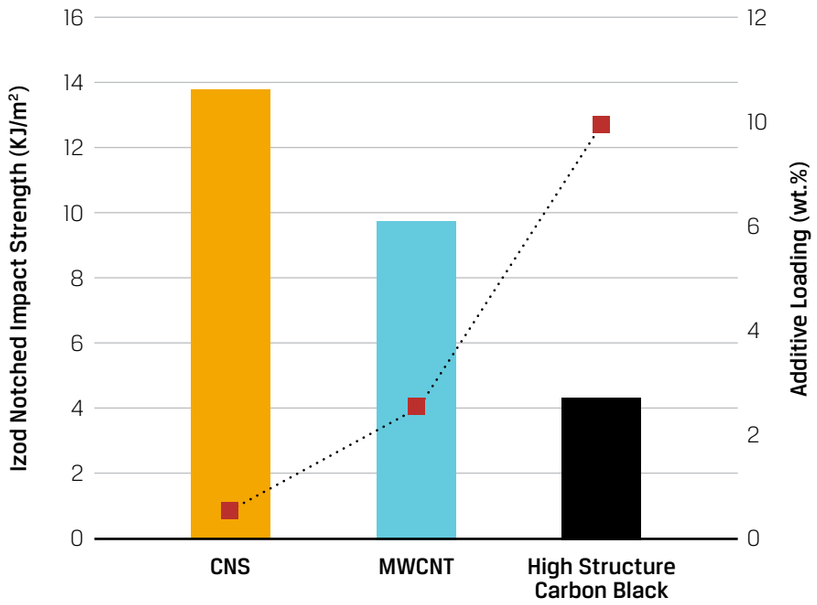


Figure 3: Comparison of notched impact strength at equivalent conductivity utilizing different conductive additives in polycarbonate compounds.

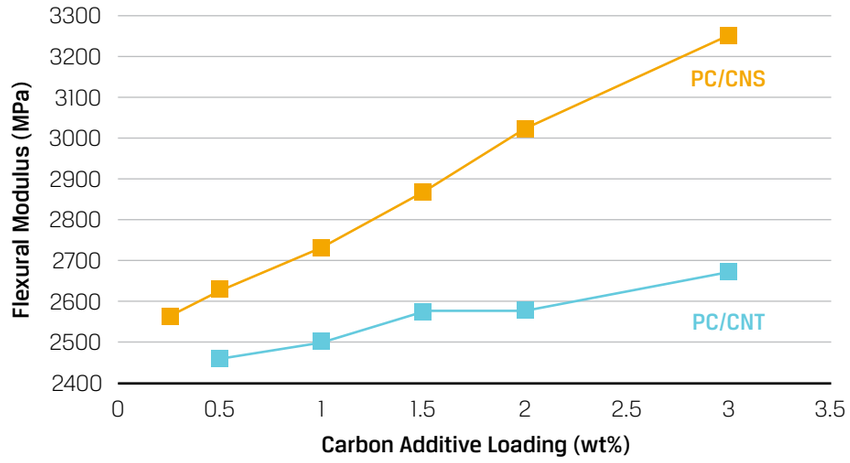


Figure 4: Mechanical performance of conductive additives in polycarbonate.

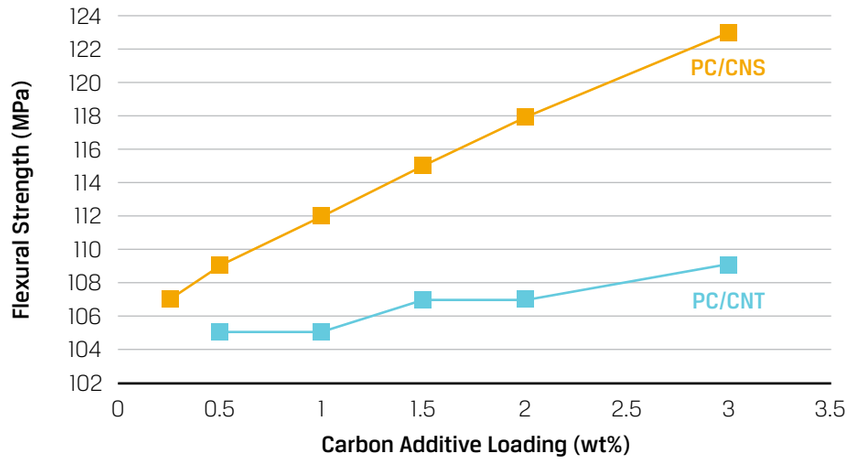


Figure 5: Flexural modulus and flexural strength of polycarbonate compounds with CNS vs. CNT.

EMI Shielding

The success of a shielding material is a function its conductivity, permeability, and geometry (thickness). ATHLOS CNS-containing products have excellent conductivity at low loadings, which enables more efficient EMI shielding properties over other conventional conductive additives in plastic compounds. ATHLOS CNS compounds have also been shown to be effective after being recycled, further differentiating them from more traditional fiber-based solutions.

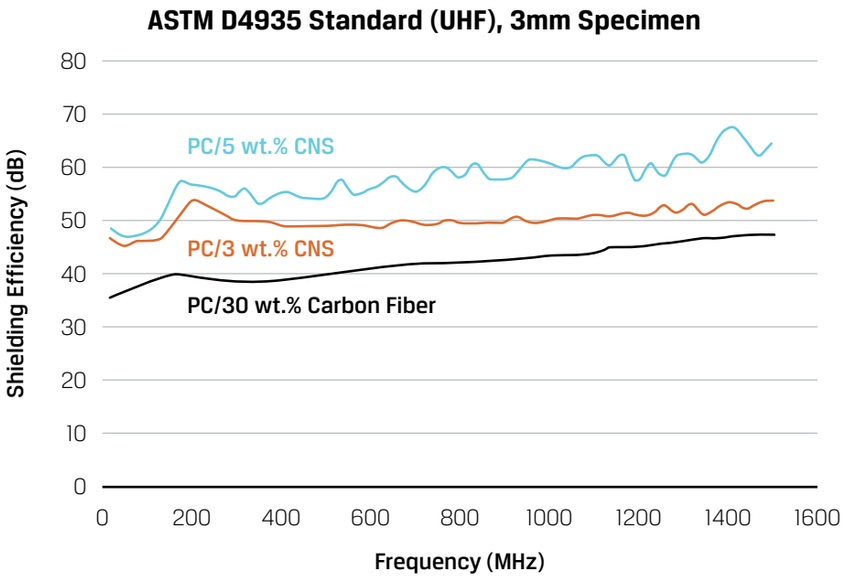


Figure 6: EMI shielding performance of polycarbonate compounds filled with CNS vs. carbon fiber at ultra-high frequencies (UHF).

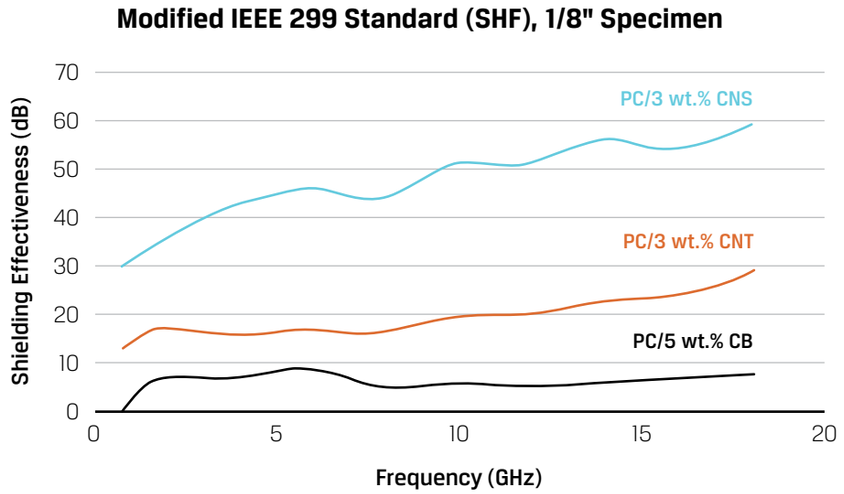


Figure 7: EMI shielding performance of polycarbonate compound filled with CNS, CNT or CB at super-high frequencies (SHF).

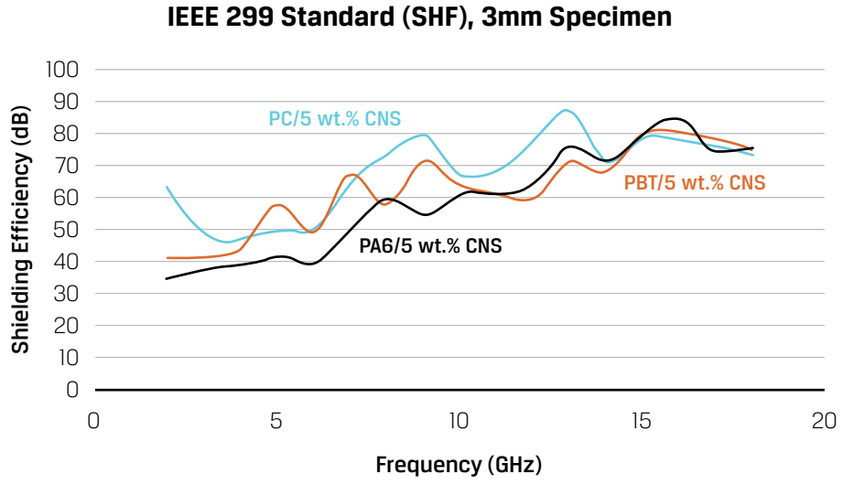
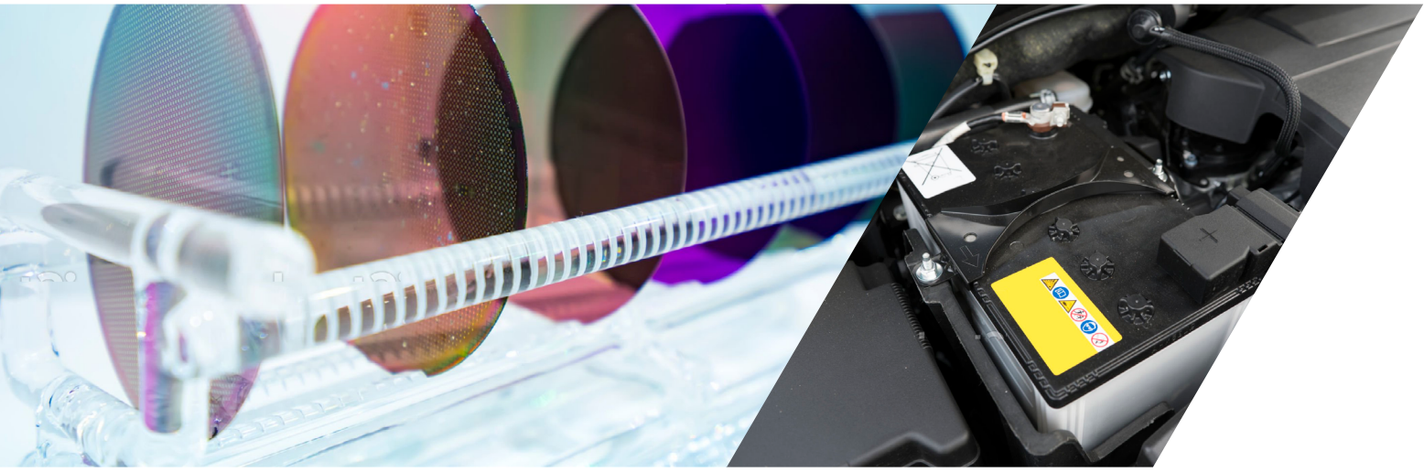


Figure 8: EMI shielding performance of different polymer compounds with CNS at super-high frequencies (SHF).

ATHLOS™ CNS Additional Value

With increasingly stringent performance requirements for electronic technologies, plastic compounders have been tasked with developing advanced formulations. Because ATHLOS CNS can achieve conductivity with less than 1% loading, compounders have more formulation space to focus on other additives, enabling the flexibility required for delivering smaller, thinner, and lighter conductive parts.

Since ATHLOS CNS contains >97% carbon and only needs to be loaded at a fraction of the loading of other carbon based solutions like multiwalled CNTs and conductive carbon black, it is an excellent choice for applications requiring high levels of purity, for example battery casings, trays, and other parts as well as plastic parts like wafer carriers and trays used in clean room applications for semi-conductors.



For more information about ATHLOS™ CNS, contact your Cabot representative or visit
cabotcorp.com//solutions/products-plus/advanced-carbons/carbon-nanostructures

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