

Abstract Submitted
for the APR21 Meeting of
The American Physical Society

Using a Novel Approach to Estimate Packing Density and Related Electrical Resistance in Multi-wall Carbon Nanotube Networks¹

CHRISTOPHER HOWARD, USHA PHILIPSE, YAN JIANG, GAVIN FARMER, MICHAEL HARCROW, CHRIS LITTLER, VINCENT LOPES, ATHANASIOS SYLLAIOS, University of North Texas, ASHOK SOOD, JOHN ZELLER, Magnolia Optical Technologies, Inc., MAGNOLIA OPTICAL TECHNOLOGIES, INC. TEAM, UNIVERSITY OF NORTH TEXAS PHYSICS DEPARTMENT TEAM — An efficient procedure for the dispersion and quantification of a network of multi-walled carbon nanotubes (MWCNTs) was developed. The dispersion technique is scalable to wafer-size samples, making the process useful in industrial applications. Using image processing, the fractal dimension factor (D) of the MWCNT network that represents its geometric complexity was determined and correlated to the areal concentration of the CNTs in the network. The less complex network that has a lower density of CNTs had the highest D factor, tending towards 2, which is the characteristic value for a two-dimensional network. The electrical resistance of the thin MWCNT network was found to scale with the areal mass density of MWCNTs by a power law, with a percolation exponent of 1.42 and a percolation threshold of 0.12 micrograms per cm^2 . The sheet resistance of the highly dense MWCNT networks was about six orders of magnitude lower than that of less dense networks; attributed to a higher number of wire contacts. The dependence of the resistance on the areal density of CNTs in the network and on CNT network complexity was analyzed to validate a two-dimensional percolation behavior.

¹Funded by DARPA and by the University of North Texas

Christopher Howard
University of North Texas

Date submitted: 11 Jan 2021

Electronic form version 1.4