Scilight

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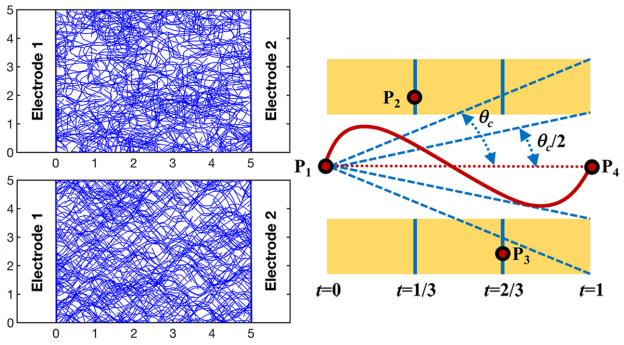
Curviness of nanowires is shown to affect their resistivity in random and aligned networks

Drew De Jarnette

Monte Carlo simulations show that the resistivity of networks made up of 1-D metal nanowires depends on their curvature, where the degree of nanowire alignment changes the optimal curvature.



In recent years, metallic nanowires have been utilized as one dimensional charge carriers for a variety of applications involving transparent conductors. The key attributes of these systems — low resistivity and high visible transparency — allow new products involving touch screens, solar cell electrodes, flexible electronics, etc. However, these systems still demand further optimization for commercialization perspectives.

A newly published report in the *Journal of Applied Physics* describes the optimization of nanowire networks as a transparent conductor by minimizing the resistivity in a Monte Carlo simulation approach. The novelty was considering the curvature of nanowires in different configurations with each nanowire having different degrees of curvature. Because nanowire systems are complex and exhibit percolation charge transport, the Monte Carlo simulations can effectively capture the bulk response from the smaller system elements.

The authors found that curvature plays an important role in minimizing the resistivity in nanowires, but the exact curvature required for a given conductive element depends on the nanowire arrangement. A random stack of nanowires connecting two electrodes demonstrated the lowest resistivity when the nanowires were perfectly straight. However, the same system with well-aligned nanowires had a minimized resistivity when the curvature was nonzero. This work, therefore, improves the predictive nature of nanowire simulations.

The result is important for both future experimental and theoretical work. Most previous simulations have assumed that nanowires are perfectly straight, which is shown here to be an insufficient description. While it is difficult to control the degree of curvature in real systems, experimentalists can now focus on this aspect to improve the performance of electrical system utilizing nanowires by focusing on their curvature.

Source: "Effect of nanowire curviness on the percolation resistivity of transparent, conductive metal nanowire networks," by Jeremy Hicks, Junying Li, Chen Ying, and Ant Ural, *Journal of Applied Physics* (2018). The article can be accessed at https://doi.org/10.1063/1.5029896.