Finding the Minimal Length for a Conductive, Random Network of Wires

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Transparent conductors are widely needed for products such as smart phones and computer mouse pads. The material currently used, Indium Tin Oxide, is expensive, brittle, and potentially short in supply. An alternative to achieve conductivity is to create random connected paths of wires. A major question for this approach is, how much material is needed for the network to be conductive? This problem is closely related to percolation theory, a field of mathematics dealing with creation of connected paths. Research into percolation theory helped determine how to approach the problem. The problem was approached both experimentally and using a computer simulation. The experimental method consisted of depositing wire segments on a surface between two electrodes, and finding at what amount of wire conductivity occurred. For the computer simulation, a program was coded in Python to randomly drop line segments and check for connected paths. Both experiment and theory showed that the length per unit area necessary for conductivity multiplied by length of each segment is a constant. An estimate of the value for this constant was found from both methods.

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