# New insights into the polymer mystique for conducting charges

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For most of us, a modern lifestyle without polymers is unthinkable… if only we knew what they were. The ordinary hardware-store terms we use for them include "plastics, polyethylene, epoxy resins, paints, adhesives, rubber"—without ever recognizing the physical and chemical structures shared by this highly varied—and talented—family of engineering materials.

Polymers increasingly form key components of electronic devices, too—and with its ever-escalating pursuit of high efficiency and low cost, the electronics industry prizes understanding specific behaviors of polymers. The ability of polymers to conduct charge and transport energy is especially appealing.

Now there's help in appreciating the polymer mystique related to the emerging field of molecular conduction in which films of charge-transporting large molecules and polymers are used within electronic devices. These include small-scale applications such as light emitting diodes (LED). At the other end of the scale, in cities and across oceans, the polymer polyethylene is the vital insulating component in the reliable and safe transport of electrical energy by high voltage underground cables.

In work appearing in the current edition of the *Journal of Applied Physics*, researchers at the United Kingdom's Bangor University describes how electrical charges may leak away to the ground through its labyrinth of molecules.

Researchers Thomas J. Lewis and John P. Llewellyn pay particular attention to the nano-scale structure of polyethylene in which crystalline regions are separated by areas known as "amorphous zones." Their novel employment of superexchange and quantum mechanical tunneling of electrons through the amorphous parts of the polymer helps improve understanding of electrical charge conduction.

"These findings could lead not only to improved properties of high voltage cables but also to a wider understanding of polymer semiconductors in device applications," said Lewis.

Their investigation shows that the tunneling feature accounts for the majority of the reported high-field charge transport effects in polyethylene.

**More information:** The article, "Electrical conduction in polyethylene: The role of positive charge and the formation of positive packets" is authored by Thomas J. Lewis and John P. Llewellyn. It appears in the *Journal of Applied Physics*. dx.doi.org/10.1063/1.4810857

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