Artificially structured metamaterials may boost wireless power transfer

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Scientists calculate that a "perfect lens," a slab of artificial material engineered to focus electromagnetic fields in ways that natural materials can't, may increase the efficiency of some wireless power transfer systems.

More than one hundred years after the pioneering inventor Nikola Tesla first became fascinated with wireless energy transfer, the spread of mobile electronic devices has sparked renewed interest in the ability to power up without plugging in. Now researchers from Duke University in Durham, N.C., and the Mitsubishi Electric Research Laboratories in Cambridge, Mass., have proposed a way to enhance the efficiency of wireless power transfer systems by incorporating a lens made from a new class of artificial materials.

When a changing electric current flows through a wire it generates a magnetic field, which in turn can induce a voltage across a physically separate second wire. Called inductive coupling, this electromagnetic phenomenon is already used commercially to recharge devices such as cordless electric toothbrushes and mobile phones, as well as in more recently developed experimental systems that can, for example, wirelessly power a light bulb across a distance of more than two meters. Finding a way to increase the inductive coupling in such systems could improve the power transfer efficiency. The research team from Duke and Mitsubishi hypothesized that a superlens, which can only be made from artificially-structured metamaterials, might be able to do the trick.

A superlens has a property call negative permeability. This means it can refocus a magnetic field from a source on one side of the lens to a receiving device on the other side. By running numerical calculations, the team determined that the addition of a superlens should increase system performance, even when a fraction of the energy was lost by passing through the lens.

When the researchers first began studying how a superlens might affect wireless energy transfer, they focused on lenses made from metamaterials that exhibited uniform properties in all directions. In their new study, accepted for publication in the American Institute of Physics' *Journal of Applied Physics*, the team also considered materials with magnetic anisotropy, meaning the magnetic properties are directionally dependent. Their results suggest that strong magnetic anisotropy of the superlens can offer further improvements to the system, such as reduction of the lens thickness and width.

More information: "Magnetic superlens-enchanced inductive coupling for wireless power transfer" is accepted for publication in the *Journal of Applied Physics.*

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