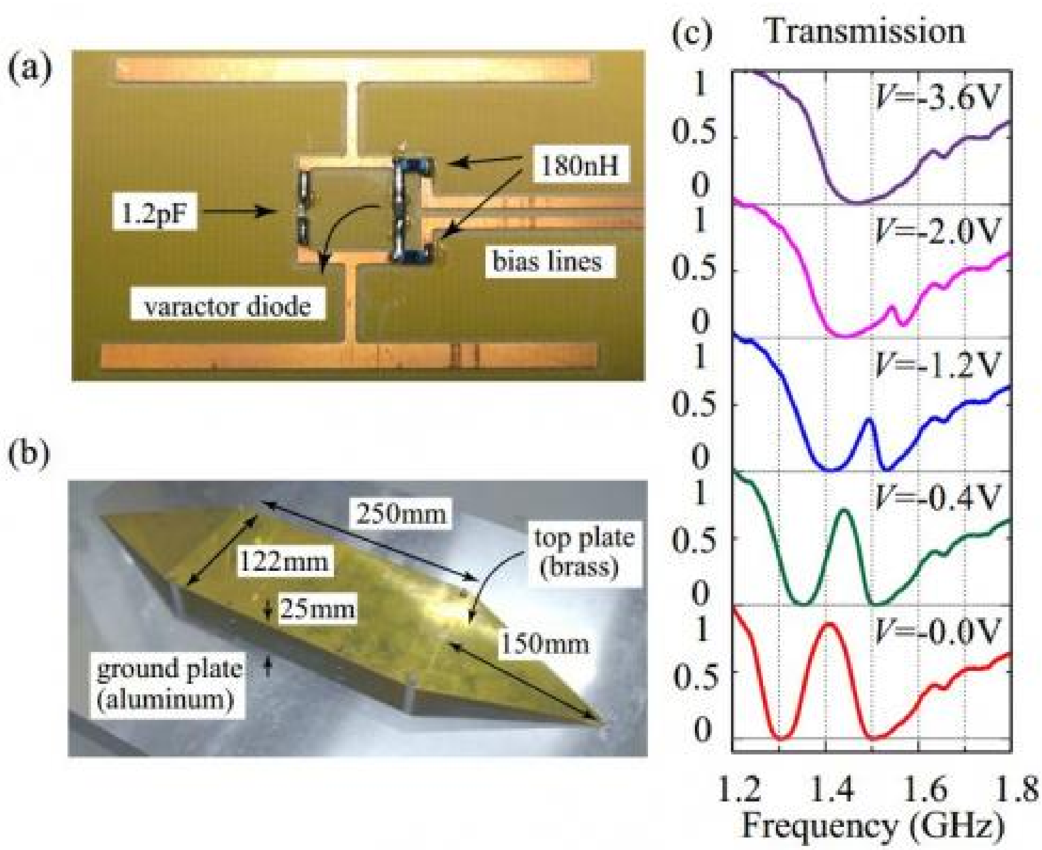
Researchers devise a way to capture and release electromagnetic waves inside a metamaterial

April 12 2013, by Bob Yirka



Photographs of (a) the unit structure and (b) the waveguide. (c) Transmission spectra for various bias voltages. Credit: arXiv:1304.2443 [physics.optics]

(Phys.org) —A team of researchers at Kyoto University in Japan has discovered a way to capture and hold electromagnetic waves inside of a metalmaterial and then release them. As the group describes in their paper they've uploaded to the preprint server *arXiv*, the process involved creating a metamaterial with two different types of capacitors—one that absorbs or radiates waves and another that traps them.

Scientists have known since the 1990s that electromagnetic waves could be trapped, experiments had proved it. The problem since that time has been in finding a way to do it that allows the waves to remain usable afterwards. Prior to this new research, they only way to capture electromagnetic waves was by focusing them into a cloud of atoms that have the unique property of being able to absorb or allow waves to pass through depending on their frequency. Scientists discovered that they could change the frequency by shooting such atoms with a laser—first trapping the waves, then releasing them. The problem of course was that the waves didn't come out in a way that was useful. In this new effort the researchers took a different approach, using materials that don't exist in nature and that allow for not only capturing electromagnetic waves, but for releasing them in the same state they were in when they arrived.

The technique involved creating a metamaterial with repeating units, each of which contain two variable capacitors. One was developed specifically to radiate waves or absorb them at a desired frequency—the other to simply to capture and hold them. Tuning the capacitors to a common frequency causes electromagnetic waves (in this case microwaves) to be trapped, while un-tuning the capacitors allows the waves to escape, moving along their original path. Perhaps more importantly, the waves also maintained the same phase distribution as they had before striking the metamaterial—making them usable for real world applications.

The ability to capture and release electromagnetic waves without disturbing their properties holds promise for the creation of new types of devices such as those that utilize light for information storage, or sensors that can hold information until needed. It might also lead to new developments in quantum optics, which could of course help researchers looking to build the ever elusive quantum computer.

More information: Storage of Electromagnetic Waves in a Metamaterial that Mimics Electromagnetically Induced Transparency, arXiv:1304.2443 [physics.optics] arxiv.org/abs/1304.2443

Abstract

We propose a method for dynamically controlling the properties of a metamaterial that mimics electromagnetically induced transparency (EIT) by introducing varactor diodes to manipulate the structural symmetry of the metamaterial. Dynamic modulation of the EIT property enables the storage and retrieval of electromagnetic waves. We confirmed that the electromagnetic waves were stored and released, while maintaining the phase distribution in the propagating direction.

via Arxiv Blog

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