

Materials and Coatings

Negative Dielectric Constant Material

Method for a negative dielectric constant material based on ion conducting materials

NASA Langley Research Center has developed a novel negative dielectric constant material based on ion conducting materials. A negative dielectric constant material is an essential key for creating metamaterials, or artificial negative index materials (NIMs). NIMs have generated great attention due to their unique and exotic electromagnetic properties, and could be used for unique optical and microwave applications, including new methods of electromagnetic cloaking and extremely low loss communications. National Aeronautics and Space Administration



BENEFITS

- Controllable resonance frequencies from radio to optical frequency
- Effective negative dielectric constant and resonance frequency can be controlled by dopant type, temperature, concentration and effective mass of dopant
- Can be used to create novel negative dielectric constant materials and negative index materials
- Molecular level homogenous metamaterials

APPLICATIONS

- Super lenses (perfect lenses)
- Optical power limiting (eye protection from lasers)
- Optical switches and modulators
- Microwave waveguides and antennas, filters, and electromagnetic cloaking devices
- Perfect absorbers
- Nondestructive evaluation sensors (by enhancing sensitivity of the microwave nondestructive evaluation method)

schnology solution



THE TECHNOLOGY

Metamaterials or artificial Negative Index Materials (NIM) are specially designed to exhibit a negative index of refraction, which is a property not found in any known naturally occurring material. These artificially configured composites have a potential to fill voids in the electromagnetic spectrum where conventional material cannot access a response, and enable the construction of novel devices such as microwave circuits and antenna components. The negative effective dielectric constant is a very important key for creating materials with a negative refractive index. However, current methods to achieve a negative effective dielectric constant are difficult to produce, not readily applicable to producing commercial metamaterials, and can have limited tunabilty.

This invention is for a novel method to produce a material with a negative dielectric constant by doping ions into polymers, such as with a protonated poly(benzimidazole) (PBI), without complex geometric structures. The doped PBI shows a negative dielectric constant at megahertz (MHz) frequencies due to its reduced plasma frequency and an induction effect. The magnitude of the negative dielectric constant and the resonance frequency are tunable by dopant type and doping concentration.



3-D plot of minimum dielectric constant, temperature and frequency

National Aeronautics and Space Administration

The Technology Gateway

Langley Research Center

Mail Stop 151 Hampton, VA 23681 757-864-1178 LARC-DL-technologygateway@mail.nasa.gov

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More Information

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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PUBLICATIONS

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Patent Pending

