Negative Index Materials: From Theory to Reality

June 6 2006

Kent State University researchers are leading a team of scientists from eight institutions, who have been awarded a $5.5 million Multidisciplinary University Research Initiative (MURI) from the Air Force Office of Scientific Research to study self-assembled, soft optical negative index materials (NIMs).

"NIMs, which don't exist naturally, are optical materials that have a negative index of refraction," says principal investigator Peter Palffy-Muhoray, a Kent State professor of chemical-physics at the Liquid Crystal Institute.

"These metamaterials are rewriting the laws of optics, because they bend light in the opposite direction compared to their regular positive counterparts," says Oleg Lavrentovich, director of the Liquid Crystal Institute. Most people are familiar with positive materials such as eyeglasses, which must be curved in order to bend light effectively to produce a non-distorted image. In the case of negative materials, they bend light in the opposite direction and can be formed as a flat surface, creating a perfect lens with super resolution and without distortion.

Originally proposed in 1967 by Soviet physicist V. G. Veselago, the idea of negative index materials was considered wildly speculative and unrealizable. For decades, these metamaterials remained the dream of a theorist. Recently, however, scientists have learned how to create NIMs in the microwave and infrared spectra, areas invisible to the human eye. There has yet to be a NIM created for the visible spectrum of light, which is the goal of this MURI project led by Kent State scientists, who plan to work on self-assembly and optical properties of nanoparticle liquid crystal systems with negative index in the visible and near infra-red range.

"The optical behavior of negative index materials is astonishing, and it opens the door to a wide variety of new and exciting applications," says Palffy-Muhoray. The metamaterials may be used in optics and will improve surveillance and communications capabilities. Other applications include flat, apertureless imaging elements; "perfect" lenses with sub-wavelength resolution; non-destructive optical tweezers to manipulate biological cells; novel antennas; new beam steering devices; sensor protection strategies; novel band gap materials; and high-density optical storage.

Source: Kent State University

Citation: Negative Index Materials: From Theory to Reality (2006, June 6) retrieved 19 April 2024 from https://phys.org/news/2006-06-negative-index-materials-theory-reality.html