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A Step Forward to the Invisibility Cloak

Red waves turned invisible

Since "The invisible man", the scientific world has been looking for an exotic material with a negative refractive index for visible light.The new discovery of a German research team could open the door to a new generation of superlenses able to detect details finer then the wavelength of visible light and improve further development of the "invisibility cloaks" which could hide objects from the human eye, enabling supreme stealth, a reason to be terribly afraid and thrilled. Light waves are made of alternating electric and magnetic fields that interact differently with different materials as they propagate. Every material has a refractive index, describing the way the light waves bend when they enter and leave the material and the speed at which they propagate. The refractive index of normal materials is always positive: 1.0003 for air, about 1.5 for glass, 2.1 for zircon, and 2.4 for diamond. But artificial materials called "metamaterials" could have a negative refractive index. The electronic components of such material must be assembled in such a way as to resonate with the electric and magnetic fields of the light waves as they pass through. An array of coils and wires much smaller than the wavelength of light would do it, as John Pendry of Imperial College London, UK, first did it for radio waves with a frequency between 15 and 20 megahertz. Later, the technique passed to shorter wavelengths, from the microwave region to the infrared (1400 nm). These performances are next-to-invisible.The team at the University of Karlsruhe in Germany has managed to pass from infrared to red spectrum, 780 nanometres, which is visible. The new metamaterial is made by depositing a layer of silver on a glass sheet, covering this with a thin layer of nonconducting magnesium fluoride, followed by another silver layer, forming a sandwich 100 nm thick. The material was etched with an array of square holes to create a grid, similar to a wire mesh. The refractive index of the material was measured with the "phase velocity" of light as it passed through. The structure had a negative refractive index of -0.6 for light with a wavelength of 780 nm. This value drops to zero at 760 nm and 800 nm, and becomes positive at longer and shorter wavelengths from the visible spectrum. Till now, exotic effects possible with a negative refractive index - such as the ability to bend light backwards - were not detected. Gunnar Dolling, of the research team, is concentrating on studying the exotic effects. Moreover, the technology should be used in "superlenses" to see details "finer than the wavelength of visible light." "These applications are still a long way off", said Dolling.