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Metamaterials: Lenses beyond limits

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Abstract
The development of eyesight and the subsequent ability to process images was a crucial advantage in the evolution of mammalian species. By sensing light in the surroundings, animals could access a vast amount of additional information in which to explore, learn, and conquer their environment. However, our eyes – and most engineered devices – lack sensitivity to many optical information channels - such as certain wavevectors, polarization states, and intensities. Optical metamaterials can overcome this limit, significantly increasing the information that can be accessed from the environment. These nanomaterials offer precise control over the amplitude, phase, frequency, and polarization state of light in an ultra-compact, subwavelength footprint. This presentation will describe advances in metamaterials, and in particular how they can be utilized to visualize and control chiral light-matter interactions. By enhancing the absorption of circularly polarized light, we discuss how metamaterials enable a suite of applications spanning health, sustainability, and information, including i) high-sensitivity detection of chiral molecules; ii) all-optical separation of chiral molecules; iii) all-optical magnetic switching; and iv) an all-optical nanoscale diode.

Bionote
Jennifer Dionne is an associate professor of Materials Science and Engineering at Stanford and an affiliate faculty of the Wu Tsai Neurosciences Institute, Bio-X, and the Institute for Immunity, Transplantation, and Infection. She also serves as the director of Stanford's Photonics Research Center and director of the Photonics at Thermodynamic Limits Energy Frontier Research Center. Jen received her B.S. degrees in Physics and Systems Science and Mathematics from Washington University in St. Louis, her Ph. D. in Applied Physics at the California Institute of Technology in 2009, and her postdoctoral training in Chemistry at Berkeley. Her research develops new materials and microscopies to observe chemical and biological processes as they unfold with nanometer scale resolution. Her work has been recognized with the NIH Director's New Innovator Award, the Alan T. Waterman Award, a Moore Inventor Fellowship, the Materials Research Society Young Investigator Award, and the Presidential Early Career Award for Scientists and Engineers, and was featured on Oprah's list of "50 Things that will make you say 'Wow'!". When not in the lab, Jen enjoys long-distance cycling, art, and reliving her childhood with her two young sons.