

Extreme Optics with Zero Refractive Index

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Nanotechnology has enabled the development of nanostructured composite materials (metamaterials) with exotic optical properties not found in nature. In the most extreme case, we can create materials which support light waves that propagate with infinite phase velocity, corresponding to a refractive index of zero. This zero index can only be achieved by simultaneously controlling the electric and magnetic resonances of the nanostructure. We present an in-plane metamaterial design consisting of silicon pillar arrays, embedded within a polymer matrix and sandwiched between gold layers. Using an integrated nano-scale prism constructed of the proposed material, we demonstrate unambiguously a refractive index of zero in the optical regime. This design serves as a novel on-chip platform to explore the exotic physics of zero-index metamaterials, with applications to super-coupling, integrated quantum optics, and phase matching.



Eric Mazur is the Balkanski Professor of Physics and Applied Physics and Dean of Applied Physics at Harvard University, Member of the Faculty of Education at the Harvard Graduate School of Education, and President of the Optical Society.

Mazur is a prominent physicist known for his contributions in nanophotonics, an internationally recognized educational innovator, and a sought after speaker. In education he is widely known for his work on Peer Instruction, an interactive teaching method aimed at engaging students in the classroom and beyond. In 2014 Mazur became the inaugural recipient of the Minerva Prize for Advancements in Higher Education. He has received many awards for his work in physics and in education and has founded several successful companies. Mazur is Chief Academic Advisor for Turning Technologies, a company developing interactive response systems for the education market. Mazur has widely published in peer-reviewed journals and holds numerous patents. He has also written extensively on education and is the author of *Peer Instruction: A User's Manual* (Prentice Hall, 1997), a book that explains how to teach large lecture classes interactively, and of the *Principles and Practice of Physics* (Pearson, 2015), a book that presents a groundbreaking new approach to teaching introductory calculus-based physics.

Mazur is a leading speaker on optics and on education. His motivational lectures on interactive teaching, educational technology, and assessment have inspired people around the world to change their approach to teaching.