Research Areas

Electronic, Magnetic & Photonic Materials
Energy
Nanomaterials & Nanotechnology

Research Interests

Our research program broadly studies the interaction between light and nanostructured materials, and particularly focuses on the emergent optical, electrical, and chemical properties of nanoscale materials under light concentration. By tailoring the nanoscale geometry, environment, and complex dielectric function we control the propagation of light in subwavelength dimensions, creating new materials not found in nature and improving our fundamental understanding of light absorption, emission, and carrier collection. These concepts are applied to areas including solar energy conversion, optoelectronic devices, and chemical and biological sensing. We are especially interested in studying plasmonic materials, colloidal nanoparticles, and metamaterials, in addition to their interactions with atoms, molecules, and semiconductors. We design nanostructures using a combination of experimental and theoretical techniques, synthesize our structures using both bottom-up and top-down methods, characterize the electrical and optical properties, and ultimately integrate our designs into functional devices and systems. Our research is highly interdisciplinary and combines principles from physics, chemistry, materials science, chemical engineering, and electrical engineering. Our current research interests include: (1) improving the efficiency and reducing the cost of solar cells through nanophotonic design, (2) enhancing light extraction for solid-state lighting, and (3) three-dimensional self-assembly of plasmonic nanoparticles with novel optical properties.

Awards

NSF CAREER Award, 2016
AFOSR Young Investigator Award, 2016
Demetriades-Tsafka-Kokkalis Thesis Award, California Institute of Technology, 2011
Selected Publications

Bronstein, N.; Li, L.; Yao, Y.; Xu, L.; Ferry, V. E.; Alivisatos, A. P.; Nuzzo, R. G. Luminescent solar concentration with semiconductor nanorods and transfer-printed micro-silicon solar cells. ACS Nano


Deceglie, M. G.; Ferry, V. E.; Alivisatos, A. P.; Atwater, H. A. Design of nanostructured solar cells using coupled optical and electrical modeling, Nano Lett., 2012, 12, 6, 2894-2900.

Ferry, V. E.; Polman, A.; Atwater, H. A. Modeling light trapping in nanostructured solar cells, ACS Nano, 2011, 5, 12, 10055-10064.

Ferry, V. E.; Verschuuren, M. A.; van Lare, M. C.; Schropp, R. E. I.; Atwater, H. A.; Polman, A. Optimized spatial correlations for broadband light trapping nanopatterns in high efficiency ultra-thin film a-Si:H solar cells, Nano Lett., 2011, 11, 10, 4239-4245.


Ferry, V. E.; Verschuuren, M. A.; Li, H. B. T.; Verhagen, E.; Walters, R. J.; Schropp, R. E. I.; Atwater, H. A.; Polman, A. Light trapping in ultrathin plasmonic solar cells, Optics Express, 2010, 18, 102, A237.

