Engineering Nanophotonic Materials for Imaging, Optical Computing, and Quantum Technologies

Controlling how light interacts with matter is central to modern science and technology. Advances in nanophotonics now allow us to engineer optical properties from the bottom up, by designing materials and structures that manipulate light at the atomic and molecular scale. In this colloquium, I will provide an overview of our interdisciplinary research program in the Metamaterials and Nanophotonic Devices Laboratory, which bridges physics, chemistry, materials science, and electrical engineering.

I will highlight several directions where our work has opened new opportunities: DNA-assembled nanoparticle lattices that enable programmable control over collective optical responses; inverse-designed metasurfaces that perform real-time imaging and optical computing tasks; and hybrid platforms where quantum dots and rare-earth ions are integrated with resonant photonic structures to enhance light–matter interactions for quantum technologies. Throughout the talk, I will emphasize how machine learning, 3D printing, and bottom-up assembly expand the design space for photonic devices, uniting concepts across disciplines.

By presenting examples that range from classical imaging and spectroscopy to emerging quantum information science, my goal is to illustrate how nanoscale design of light–matter interactions can help shape the next generation of photonic technologies.

Short Biography

Dr. Koray Aydin is a Professor in the Department of Electrical and Computer Engineering and Applied Physics Graduate Program, where he leads the Metamaterials and Nanophotonic Devices Laboratory. He received his B.S. and Ph.D. degrees in Physics from the Bilkent University in 2002 and 2008, respectively. He worked as a postdoctoral researcher between 2008-2010 and a research scientist between 2010-2011 at the California Institute of Technology under the supervision of Prof. Harry Atwater. His research interests span several cross-cutting research directions in nanophotonics, including metamaterials and metadevices, plasmonics, inverse-design and machine-learning assisted nanophotonic design, 2D materials, phase-change materials, DNA-assembled and 3D printed nanophotonic materials. Dr. Aydin received the prestigious 2017 ONR Young Investigator Program Award. In 2019, he is selected as The Top Outstanding Young Person (TOYP) in Turkey in the field of scientific and technological development. His work bridges physics, chemistry, materials science, and engineering, with applications ranging from imaging and computation to quantum information.