

# Quantum Meta-Photonics

**Vladimir M. Shalaev**

School of Electrical and Computer Engineering, Birck Nanotechnology Center and Purdue Quantum Science and Engineering Institute, Purdue University, West Lafayette, IN 47907, USA

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The Quantum Science Center (QSC), a National Quantum Information Science Research Center of the U.S. Department of Energy (DOE), Oak Ridge, TN 37931

E-mail address: shalaev@purdue.edu

Integrated photonic technologies are essential for efficient generation, manipulation, and detection of quantum states of light and can potentially enable a high density of on-chip photonic qubits and the level of performance required for the practical realization of various applications in the quantum domain. Our group recently discovered bright, stable, linearly polarized, and high-purity sources of single-photon emission at room temperature in scalable platform based on SiN [1]. We successfully demonstrate the integration of intrinsic quantum emitters with planar SiN waveguides and demonstrate single-photon emission coupling into the waveguide mode [2].

We also show a roadmap based on employing plasmonic metamaterials to enhance the light-matter interaction and speed up single-photon emission so that it can outpace the dephasing time and achieve quantum coherence even at non-cryogenic temperatures [3,4]. By employing low-loss plasmonic nanocavity we show greatly enhanced emission from spin defects in hexagonal boron nitride [5].

Our findings spark further studies of quantum emitters toward deeper understanding of their nature, deterministic formation, and scalable integration with on-chip quantum photonic circuitry. We also demonstrate a hybrid platform based on the electrically controlled magnon coupling of spin qubits, with important quantum computing and networking applications [6].

Finally, we show that employing machine learning is a key step in realizing integrated quantum circuitry for scalable quantum applications [7].

## References

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