Engineered Materials Platforms for Quantum and Advanced Photonic Technologies

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The progress of scalable quantum technologies relies strongly on the development of materials with precisely controlled optical, electronic, and structural properties. At ENSEMBLE3 CoE, we focus on designing and engineering a broad spectrum of functional materials — including oxide single crystals, III–V compound semiconductors, eutectic architectures, and glass-based nanocomposites — tailored for emerging optoelectronic and quantum applications.

Among these systems are plasmonic glass materials hosting optically switchable metastable defects that can be controlled using laser illumination and thermal treatment. Owing to their stable and tunable luminescent states, as well as compatibility with integrated platforms, these materials offer promising opportunities for nanoscale data storage, optical writing and erasing, and quantum information processing.

We have also developed bulk plasmon–exciton nanocomposites exhibiting ultrafast and spectrally narrow luminescence at room temperature, which may serve as a basis for quantum light sources and high-speed photonic switching.

In this talk, we present ENSEMBLE3's comprehensive materials strategy, combining crystal growth, micro- and nanostructuring, and functional material design to create scalable platforms for next-generation quantum communication, sensing, and computing technologies.