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High-Resolution Optical Storage Enabled by Upconversion-Charged Persistent Phosphors

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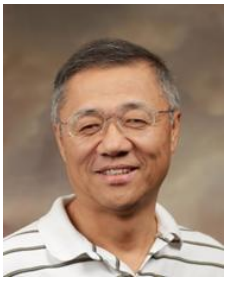
We present a novel approach to high-resolution optical data storage based on upconversion charging (UCC) in persistent phosphors. Using $Gd_3Ga_5O_{12}:Cr^{3+}$ as a model system, we demonstrate that UCC—characterized by a nonlinear, two-step ionization mechanism—enables rapid and precise data writing. With exposure times as short as 0.01 seconds per bit using a compact laser engraver with visible diode lasers, this method offers a compelling combination of speed, energy efficiency, and portability. Beyond high-resolution writing, the system supports stable, long-term data retention and reliable rewritability. We further validate the broad applicability of this storage strategy across multiple host materials, utilizing both thermal and optical stimulation for readout. These findings position UCC-enabled phosphors as a promising platform for next-generation optical storage technologies.



Short Bio:

Dr. Xiaojun Wang received his B.S. in Physics from Jilin University, China, and his Ph.D. in Physics from the University of Georgia, USA. He is currently a Professor of Physics at Georgia Southern University. Dr. Wang serves as an editor for *Light: Science & Applications*, Editor-in-Chief of *Materials Research Bulletin*, and is a Fellow of the American Physical Society.