Ultrathin Nanopatterned Metal Films for Highly Transmissive Plasmonic Subtractive Color Filters

Beibei Zeng, Yongkang Gao, Filbert J. Bartoli
Electrical and Computer Engineering Department, Lehigh University, Bethlehem, PA 18015
E-mail*fjb205@lehigh.edu*

Nanopatterned ultrathin plasmonic metal layers are investigated for use as miniaturized subtractive color filters. Plasmonic color filters employing a single optically-thick nanostructured metal layer have recently generated considerable interest as an alternative to colorant-based color filtering technologies, due to their reliability, ease of fabrication, and high color tunability. However, their relatively low transmission efficiency (~30%) needs to be significantly improved for practical applications. The present work reports, for the first time, a novel plasmonic subtractive color filtering scheme that exploits the counter-intuitive phenomenon of extraordinary low transmission (ELT) through an ultrathin nanostructured metal film. This approach relies on a fundamentally different color filtering mechanism than that of existing plasmonic additive color filters, and achieves unusually high transmission efficiencies of 60~70% for simple architectures. Furthermore, owing to short-range interactions of surface plasmon polaritons at ELT resonances, our design offers high spatial resolution color filtering with compact pixel size close to the optical diffraction limit (~λ/2), creating solid applications ranging from imaging sensors to color displays.