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Self-Complementary Plasmonic Structures for High Efficiency Broadband Absorber in the Visible Range TIANYI SUN, Boston College, YANG WANG, South China Normal University, ZHIFENG REN, KRZYSZTOF KEMPA, Boston College — We demonstrate, by simulation, that a planar 3-layer structure on a metal substrate can highly absorb electromagnetic radiation in the entire visible range, which can become a potential platform for high-efficiency broadband absorber. Such a structure consists of an ultrathin semiconducting layer topped with a solid nanoscopically perforated metallic film and then a dielectric interference layer. It is shown that the perforated metallic film and the ultrathin absorber form an effective metamaterial film, which negatively refracts light in this broad frequency range. Our quantitative simulation confirms that the absorption bandwidth is maximized at the self-complementary pattern of the percolation threshold. If amorphous silicon (a-Si) is selected as the ultrathin semiconducting material, the absorbance of the structure with a checkerboard-patterned perforated metallic film is about 90% in the visible range (from 400 nm to 700 nm), where 80% goes into the a-Si layer and the other 10% being absorbed by other layers. Further simulation shows that for a single p-i-n a-Si junction, the energy conversion efficiency of an optimized structure can exceed 12%.

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