Photonic Nanoparticles for Hydrogen Production and Biosensing

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The development of reliable green energy supplies presents fundamental challenges to modern science and engineering. Among the various renewable energy sources, solar hydrogen is one of the most promising. To this end, the development of effective light-driven photocatalysts for water splitting represents a critical and ever-growing need. However, most photocatalyst materials suffer from low solar-to-fuel conversion efficiency due to the limited range of their light absorption and their high electron-hole recombination rates under irradiation. Our multipronged strategies that are designed to mitigate these problems utilize photonic nanoparticles having systematically tunable extinctions ranging from ultraviolet to visible to near infrared (NIR) wavelengths [1]. These nanoparticles serve as versatile nanoscale tools, where the particles can be optically detected and powered by solar radiation. Highlighted here will be the preparation, characterization, and hydrogen-generating capacity of photonic nanoparticles that possess a variety of dimensions, chemical compositions, and optical properties [2, 3]. The exploration and development of next-generation nanoparticles and composite catalysts will provide enhanced power conversion efficiencies for solar cells, which will lead to efficient fuel-cell systems and self-powered structures with integrated energy harvesting/storage capabilities. Separate studies of hollow bimetallic nanostars, a new photonic nanoparticle architecture, will also be described. These unique nanomaterials exhibit attractive optical properties for enhancing bioassays and Raman-based biosensing [4, 5].

References

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