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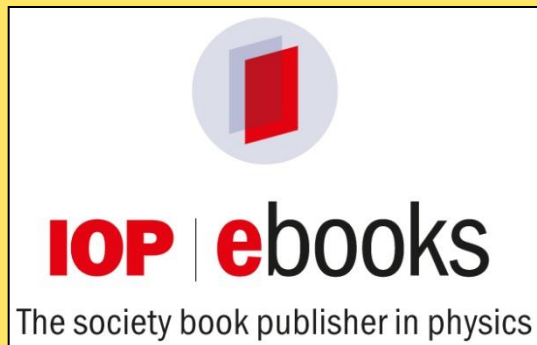


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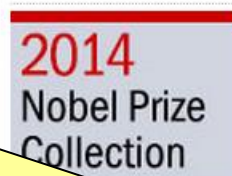
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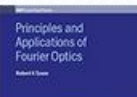
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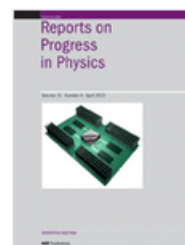
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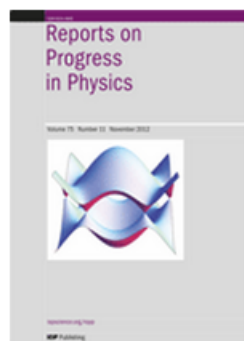
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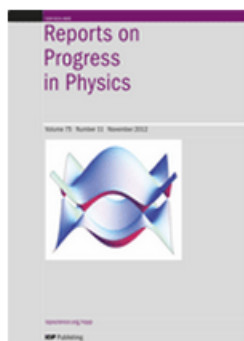
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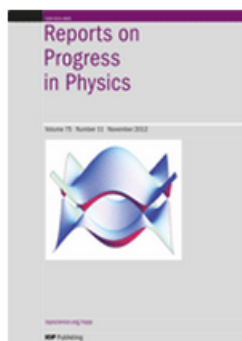
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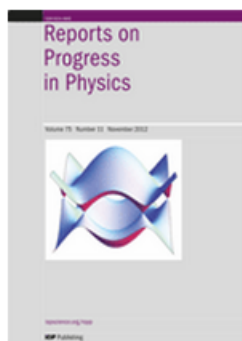
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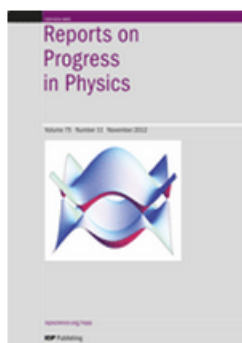
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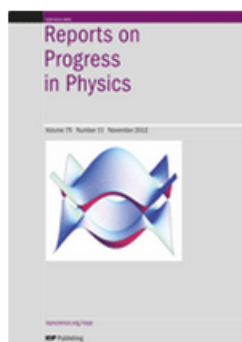
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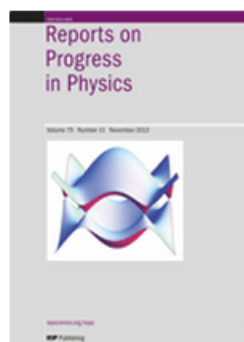
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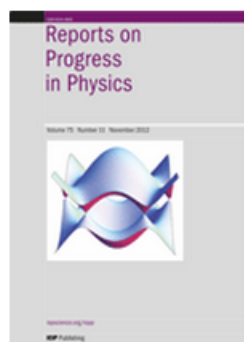
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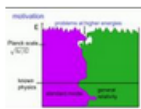
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Plasmonic photocatalysis has recently facilitated the rapid progress in enhancing photocatalytic efficiency under visible light irradiation, increasing the prospect of using sunlight for environmental and energy applications such as wastewater treatment, water splitting and carbon dioxide reduction. Plasmonic photocatalysis makes use of noble metal nanoparticles dispersed into semiconductor photocatalysts and possesses two prominent features—a Schottky junction and localized surface plasmonic resonance (LSPR). The former is of benefit to charge separation and transfer whereas the latter contributes to the strong absorption of visible light and the excitation of active charge carriers. This article aims to provide a systematic study of the fundamental physical mechanisms of plasmonic photocatalysis and to rationalize many experimental observations. In particular, we show that LSPR could boost the generation of electrons and holes in semiconductor photocatalysts through two different effects—the LSPR sensitization effect and the LSPR-powered bandgap breaking effect. By classifying the plasmonic photocatalytic systems in terms of their contact form and irradiation state, we show that the enhancement effects on different properties of photocatalysis can be well-explained and systematized. Moreover, we identify popular material systems of plasmonic photocatalysis that have shown excellent performance and elucidate their key features in the context of our proposed mechanisms and classifications.

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Abstract

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Plasmonic photocatalysis, which utilizes semiconductors to absorb photons to create active electrons and holes, which can then enhance photocatalytic efficiency under visible light irradiation, is a promising technology for environmental and energy applications such as wastewater treatment, water splitting and hydrogen production. Plasmonic photocatalysis makes use of noble metal nanoparticles dispersed into semiconductor photocatalysts, forming a Schottky junction and localized surface plasmonic resonance (LSPR). The former is of benefit to charge separation and transfer whereas the latter contributes to the strong absorption of visible light and the excitation of active charge carriers. This article aims to provide a systematic study of the fundamental physical mechanisms of plasmonic photocatalysis and to rationalize many experimental observations. In particular, we show that LSPR could boost the generation of electrons and holes in semiconductor photocatalysts through two different effects—the LSPR sensitization effect and the LSPR-powered bandgap breaking effect. By classifying the plasmonic photocatalytic systems in terms of their contact form and irradiation state, we show that the enhancement effects on different properties of photocatalysis can be well-explained and systematized. Moreover, we identify popular material systems of plasmonic photocatalysis that have shown excellent performance and elucidate their key features in the context of our proposed mechanisms and classifications.

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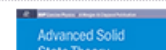
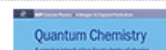
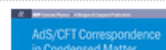
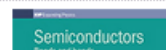
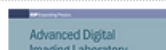
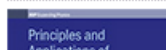
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