Plasmonic nanoparticles with applications in energy and sustainability

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The intense research activity of the past two decades focused on the collective electronic oscillations in high-electron-density media, known as surface plasmons, has led to multiple breakthroughs in fields ranging from chemical sensing and catalysis, to active optical devices, solar light harvesting, even nanomedicine. For many of these applications, the original focus on noble metals may ultimately limit their transition from the research laboratory to widely used commercial technologies. We will describe several research directions that, as they point towards more sustainable materials, open up new research opportunities. Aluminum, the most abundant metal on earth, opens the door to new opportunities for active devices and a new modular approach to plasmon-enabled photocatalysis.[1] Graphene in its smallest form, that of polycyclic aromatic hydrocarbon molecules, can support intense, optical frequency plasmon oscillations with the addition or removal of a single electron from the neutral molecule.[2] In applications that directly address sustainability, we will discuss how plasmonic nanoparticles can be used for solar distillation of liquid mixtures, providing insight into the mechanism of nanoparticle-based distillation that in certain cases allows the distillation fraction to deviate dramatically from conventional thermal distillation processes.[3]

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