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Photodetector Engineering with Plasmonic Properties

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Abstract : In the article, the main goal is to study the effect of the plasmonic properties on the photocurrent generated by a photodetector. Fundamentally, a typical photodetector is designed and simulated using the finite element methods. To utilize the plasmonic effect, gold nanoparticles with different shape, size and morphology are buried into the intrinsic region. Plasmonic effect is arisen through the interaction of the incoming light with nanoparticles by which electrical properties of the photodetector are manipulated. In fact, using plasmonic nanoparticles not only increases the absorption bandwidth of the incoming light, but also generates a high intensity near-field close to the plasmonic nanoparticles. Those properties strongly affect the generated photocurrent. The simulation results show that using plasmonic nanoparticles significantly enhances the electrical properties of the photodetectors. More importantly, one can easily manipulate the plasmonic properties of the gold nanoparticles through engineering the nanoparticles' size, shape and morphology. Another important phenomenon is plasmon-plasmon interaction inside the photodetector. It is shown that plasmon-plasmon interaction improves the electron-hole generation rate by which the rate of the current generation is severely enhanced. This is the key factor that we want to focus on, to improve the photodetector electrical properties.

Keywords : plasmonic photodetector, plasmon-plasmon interaction, Gold nanoparticle, electrical properties
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