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The Effect of Surface Plasmon on Internal Photoemission Measured on Ag/TiO_2 Nanodiodes

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Over the last several decades, innovative light-harvesting devices have evolved to achieve high efficiency in solar energy transfer. Research on the mechanisms for plasmon resonance is very desirable to overcome the conventional efficiency limits of photovoltaics. The influence of localized surface plasmon resonance on hot electron flow at a metal-semiconductor interface was observed with a Schottky diode composed of a thin silver layer on TiO_2. The photocurrent is generated by absorption of photons when electrons have enough energy to travel over the Schottky barrier and into the titanium oxide conduction band. The correlation between the hot electrons and the surface plasmon is confirmed by matching the range of peaks between the incident photons to current conversion efficiency (IPCE, flux of collected electrons per flux of incident photons) and UV-Vis spectra. The photocurrent measured on Ag/TiO_2 exhibited surface plasmon peaks; whereas, in contrast to the Au/TiO_2, a continuous Au thin film doesn't exhibit surface plasmon peaks. We modified the thickness and morphology of a continuous Ag layer by electron beam evaporation deposition and heating under gas conditions and found that the morphological change and thickness of the Ag film are key factors in controlling the peak position of light absorption.

Keywords: Ag, Surface plasmon resonance, Schottky barrier, Photovoltaics