Plasmonic Hot Carrier Detection via $SrTiO_3$ Interfacial Layer

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Energetic hot carrier injection from metal plasmonic structure to adjacent semiconductor lies at the center of the application of non-radiative decays, photochemical reactions and energy harvesting. Plasmonic hot-electron devices, till now, have been highly focused on a Schottky barrier structures to separate the energetic carriers before the thermalization. For instance, much efforts were putted in exploring high absorption structure with enough thin metal; enough thin compared to mean free path. However, interfacial engineering of the device; exploring a new device structure, have not been fully investigated.

In this study, we observed stable and boosted photocurrents upon resonant plasmonic excitation with ultrathin SrTiO3 interfaces. This lattice matched inorganic perovskite between metal and Si can be initially functionalized as a conducting layer due to the nanofilament formation via soft dielectric breakdown technique. We verified the superior stability of devices incorporating a SrTiO3 layer by studying the photo-response, tunability and barrier height under high reverse biases. These observations remarkably expand contemporary knowledge on the hot carrier behaviors surpassing the interfaces, and are beyond conventional considerations for designing a functional Schottky photodetectors, which working wavelengths are below the semiconductor bandgaps. We believe that the investigation paves the way toward plasmon-induced photodetection for practical applications.

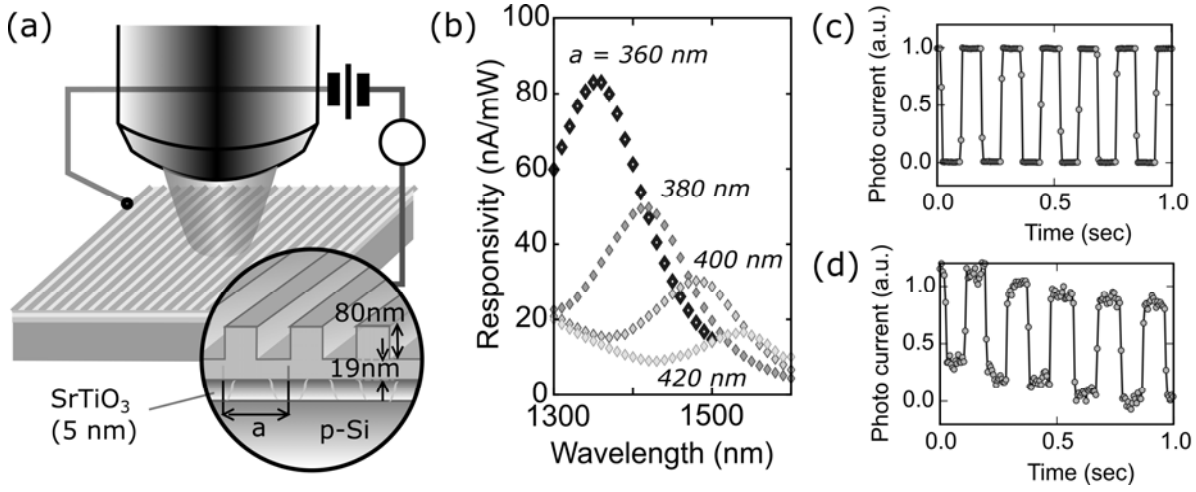

Fig. 1 (a) Schematic of proposed device, (b) Measured photo-responsivity of the device, (c) Temporal photo-induced current response of the device with $SrTiO_3$ under 10 V reverse bias. (d) Without $SrTiO_3$.

[Reference]T. Matsui, Y. Li, M-H. M. Hsu, C. Merckling, R. F. Oulton, L. F. Cohen, and S. A. Maier, *Adv. Funct. Mater.* **28**, 1705829 (2018).