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PROCEEDINGS

Kinetic Photovoltage from Moving Boundaries of Electrical Double Layer

Jun Yin[1,*] and Jidong Li[1]

[1] State key laboratory of mechanics and control of mechanical structures, Nanjing University of Aeronautics and Astronautics, Nanjing, 210016, China

[*] Corresponding Author: Jun Yin. Email: yinjun@nuaa.edu.cn

ABSTRACT

External photo-stimuli on heterojunctions commonly induce an electric potential gradient across the interface therein, such as photovoltaic effect, giving rise to various present-day technical devices. In contrast, in-plane potential gradient along the interface has been rarely observed. Here we show that moving a light beam at the semiconductor-water interface, i.e. creating a moving boundary of electrical double layers between the illuminated and dark regions, induce a potential gradient along the semiconductor. It is attributed to the following movement of a charge packet in the vicinity of the silicon surface, whose formation is driven by a built-in electrical field associated with interface capacitance [1]. By applying a bias at the semiconductor-water interface, a transistor-inspired gate modulation of kinetic photovoltage is further developed. The kinetic photovoltage signals can be facilely switched on/off due to the electrical-field-modulated surface band bending. In contrast to the function of solid-state transistors relying on external sources, passive gate modulation of the kinetic photovoltage is achieved simply by introducing a counter electrode with materials of desired electrochemical potential. This architecture opens up a new way for silicon-based photoelectronics and self-powered optoelectronic logic devices.

KEYWORDS

Kinetic photovoltage; electrical double layers; moving boundary; gate modulation

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