

GaAs/TiO₂ core-shell nanowires for Solar Water Splitting

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Concerning the eco problem and energy crisis we are facing now, the energy harvested from sunlight offers a desirable approach [1]. Photoelectrochemical (PEC) hydrogen production from water provides a way to directly convert the solar energy into a storable clean fuel [2]. GaAs nanowire (NW) configuration is preferred for the high specific surface area as well as the good light absorption [3]. It can serve as a model system to demonstrate the quality of NW-array light absorber. However GaAs suffers the photo-corrosion in aqueous electrolytes [4]. TiO₂ is mainly used to passivate semiconductor electrodes for its remarkable stability [4, 5], which may well enhance the stability of GaAs based electrodes.

Self-catalyzed GaAs NWs were grown on Si(111) substrate by molecular beam epitaxy (MBE). Then, a 5 nm-thick TiO₂ layer was also deposited via MBE on the GaAs NWs (Figure 1 a). For the bare GaAs NW array, the current density is about -0.135 mA/cm² at 0.033 V vs RHE, and the V_{onset} is -0.47 V. After passivated by the amorphous TiO₂ layer, only a small transient current is detected (Figure 1 b). However, the photocurrent also decreases due to the poor conductivity of TiO₂. The optimization of the PEC performances of TiO₂ passivated GaAs NW array is being worked on.

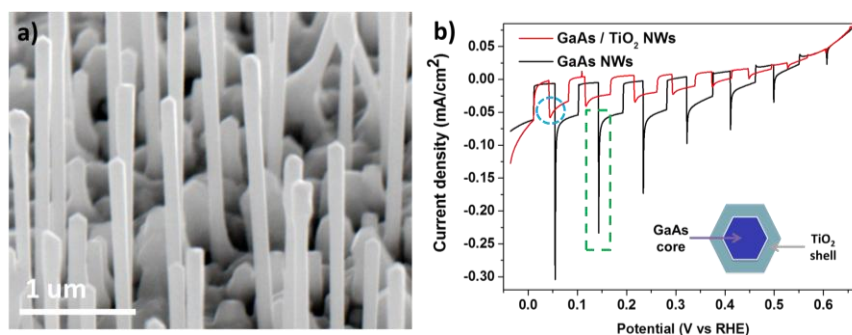


Figure 1: a) SEM image of the GaAs / TiO₂ NW array, b) PEC responses (on-off curve) of the GaAs NWs array and GaAs / TiO₂ NW array in NaOH solution (pH=13).

Références:

- [1] J. Gu *et al*, *Nat. Mater.* **2016**, 15, 456-460.
- [2] M. G. Walter *et al*, *Chem. Rev.* **2010**, 110, 6446-6473.
- [3] S. Hu, *et al*, *Energ. Environ. Sci.* **2013**, 6 (6), 1879-1890.
- [4] S. Hu *et al*, *Sci.* **2014**, 344, 1005-1009.
- [5] J. Qiu *et al*, *Chemistry of Materials* **27** (2015), 7977-7981.