Graphene based hybrid structures for solar-driven water splitting

Xiao Li[1], Hongwei Zhu[2]

[1]School of Mechanical Engineering, Southeast University, Jiangning District, Nanjing, China
[2]School of Materials Science & Engineering, Tsinghua University, Haidian District, Beijing, China
liyixiaofeng@126.com

Abstract

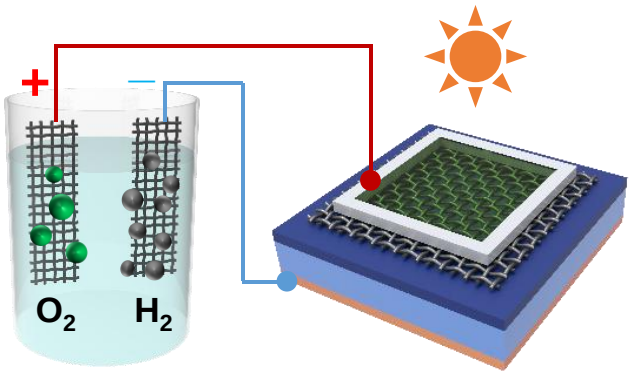
Developing clean and renewable energy has been considered as one of the most effective ways to address the energy and environmental related crisis. One of the most powerful sustainable energy, solar energy, can be utilized through solar−driven water splitting, which contains two energy conversion units. One is the photovoltaic solar cell, which converts light energy to electric energy for power supply. The other is the water electrolysis unit, which converts electric energy to hydrogen energy by using highly efficient and stable catalysts. Graphene and its hybrid nanocomposites, with their excellent optical, electrical and mechanical properties, can be applied in this system, to further improve the photoelectric conversion efficiency, and decrease the electrical consumption in the water electrolysis module.

Herein, to develop the solar−driven water splitting system, first, a hybrid graphene/Si−solid electrolyte solar cell is fabricated by combining graphene with solid electrolyte, achieving a conversion efficiency to be 11%, acting as the photoelectric conversion unit in this system. Then, water electrolysis catalysts are prepared by simply depositing transition metal (Co, Ni) based selenides on the conductive graphene substrate, which largely reduce the noble metal consumption in hydrogen production, realizing the conversion of electric energy to hydrogen energy at low cost. By connecting the solar cell and water electrolysis unit in tandem, a solar−driven water splitting system is constructed, with the highest solar-to-hydrogen conversion efficiency to be 6.65%.

References

[1] Xiao Li, et al, Adv. Energy Mater., **4** (2014) 1400224.
[2] Xiao Li, et al, J. Mater. Chem. A, revised (2016).

Figures



Water electrolysis unit Photovoltaic solar cell