**Ion beam modification of photo/electrochemical electrodes for water splitting**

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Ion beam technology is a powerful method to fabrication and modify the properties of materials. In this talk, we report that ion beam technology can be a novel way for modification of photo/electrochemical electrodes for water splitting and improve their performance.

We demonstrate that the performance of TiO2/Fe2O3 nanorod, g-C3N4/NiFe-LDH nanosheet electrodes for photoelectrochemical water oxidation can be effectively enhanced through doping of O/N vacancies produced by ion irradiation. The ion irradiation is a simple method to introduce vacancies both on the surface and in the interior of materials for making deficient materials. Positron annihilation spectroscopy was used to study the type of the formed vacancies. The modified photo/electrochemical electrodes exhibit obvious increase in the performance of photoelectrochemical water splitting under light irradiation. The photoconversion efficiency η of the TiO2-x photoanode is 0.5-fold higher than that of the pristine TiO2 photoanode. Defect-engineered g-C3N4 shows highly improved performance under optimized conditions, the defective g-C3N4 exhibits a significantly higher (2.7-fold) hydrogen evolution rate than that of the pristine g-C3N4 nanosheets under visible light (λ>420 nm) illumination. A nanosheet structured NiO/NiFe2O4 heterostructure with rich oxygen vacancies converted from NiFe-LDH by Ar+ ions irradiation shows significant enhancement in both OER and hydrogen evolution reaction performance with an large decrease of overpotential from 395 mV at 10 mA cm-2 of the as-prepared NiFe LDH/Ti to 279 mV of the irradiated sample.

Combining experimental with theoretical study, this study demonstrates that ion irradiation technique combing with thermal annealing could be an effective way to enhance the performance of photoanode for water splitting.

**References**

* Zhong H., Gao G., Wang X., Wu H., Shen S., Zuo W., Cai G., Wei G., Shi Y., Fu, D., Jiang C., Wang L., **Ren F.**, Ion Irradiation Inducing Oxygen Vacancy-rich NiO/NiFe2O4 Heterostructure for Enhanced Electrocatalytic Water Splitting, Small (2021) 2103501.
* Wang X., Wan W., Shen S., Wu H., Zhong H., Jiang C., **Ren F.** , Application of Ion beam Technology in (Photo)electrocatalysis Materials for Renewable Energy, Appl. Phys. Rev., 7 (2020) 041303.
* Wu H., Wu L., Shen S., Liu Y., Cai G., Wang X., Qiu Y., Zhong H., Xing Z., Dai Z., Jiang C., **Ren F.**, Enhanced photoelectrochemical performance of an α-Fe2O3 nanorods photoanode with embedded nanocavities formed by helium ions implantation, Inter. J. Hydrog. Energy, 45 (2020) 9408-9415.
* Wang X., Wu L., Wang Z., Wu H., Zhou X., Ma H., Zhong H., Xing Z., Cai G., Jiang C., **Ren F.**, C/N vacancy co-enhanced visible-light-driven hydrogen evolution of g-C3­N4 nanosheets through controlled He+ ion irradiation, Solar RRL 2019 (2019) 1800298.