Microwave-assisted synthesis of metal semiconductors heterojunctions with photocatalytic applications

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Abstract

Using solar light in photo-induced processes is very attractive since it is a clean and practically limitless energy source. Recently research related to the development of new photocatalysts capable of use this kind of energy has been growing. Metal semiconductors have excelled in this field, however, the development of materials capable of utilize the visible component of the radiation (major portion of the Sun fallout) it is a contemporary challenge.

My research group is focused on the development of new heterojunctions of nanostructured metal semiconductors, whose synergic effect make it possible the use of the visible radiation, resulting in improved photocatalytic activity.

The talk will be focused on the following heterojunctions: titanate nanotubes/carbon nitride, bismuth vanadate/gold nanoparticles, bismuth vanadate/tungsten oxide, bismuth niobate/gold and silver nanoparticles, and bismuth niobate/tungsten oxide.

These catalysts were synthesized through microwave-assisted routes, an emergent technique that allows quickly obtaining of the desired products, with high selectivity, high yields and low energetic consumption, in comparison to conventional synthesis methods. Thus, several methodological studies can be carried out in a short period of time, allowing the investigation of the ideal synthetic conditions to obtain nanomaterials with controlled morphology and structure. As a result, accurately establishment of new protocols of microwave-assisted synthesis, were achieved.

These heterojunctions were characterized through several techniques and applied on photodegradation of organic species and photoelectrochemical generation of H_2. For these applications a correct band alignment between the heterojunction components is required. Typically, the photogenerated electrons must flow from the external semiconductor to the host semiconductor; the photogenerated holes must flow from the host to the external semiconductor. This charge separation increases the electrons lifetime by reducing the recombination rates. Figure 1a show the band alignment of a heterojunction applied for photocatalysis and Figure 1b show a typical photoelectrochemical cell using these heterojunctions.

Image

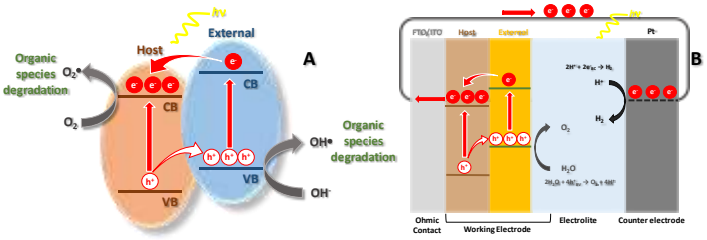


Figure 1. Typical bands alignment of metal semiconductor heterojunction for application in photocatalysis **(A)** and photoelectrocatalysis **(B)**.

Recent Publications (minimum 5)

1. Souza JS, Hirata FTH, Corio P (2019) Microwave-assisted synthesis of bismuth vanadate nanoflowers decorated with gold nanoparticles with enhanced photocatalytic activity. Journal of Nanoparticle Research 21-35.
2. Souza JS, Carvalho WM, Souza FL, Ponce-de-Leon C, Bavykin DV, Alves WA (2016) Multihierarchical electrodes based on titanate nanotubes and zinc oxide nanorods for photoelectrochemical water splitting. Journal of Materials Chemistry A 4:944-952.
3. Jian J, Jiang G, van de Krol R, Wei B, Wang H (2018) Recent advances in rational engineering of multinary semiconductors for photoelectrochemical hydrogen generation. Nano Energy 51:457-480.
4. Bilecka I, Niederberger M (2010) Microwave chemistry for inorganic nanomaterials synthesis. Nanoscale 2:1358-1374.
5. Zhu Y.-J, Chen F (2014) Microwave-assisted preparation of inorganic nanostructures in liquid phase. Chemical Reviews 114:6462-6555.

Photograph



Biography

Bachelor in Chemistry at Universidade Estadual Paulista - UNESP/ Araraquara – SP, in 2008, with an exchange period at University of Florida – EUA. Master and PhD in Science and Technology - Chemistry at Federal University from ABC – SP – in 2011 and 2016, respectively. Exchange PhD at University of Southampton – UK – in 2014. Post-Doctorade in Fundamental Chemistry at University of São Paulo – SP – in 2017. Currently she is Adjunct Professor – level A at Federal University from ABC. Her main research area is in Inorganic Chemistry, studying the synthesis of semiconductors metal oxides through microwave-assisted methodologies, preparation of multihierarchical systems, heterogeneous catalysis, photocatalysis and photoelectrocatalysis and development of devices for energy conversion.

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