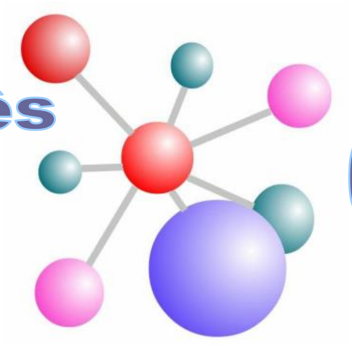
UFRN
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

Exame de Proficiência 2015.2

Inglês



Ciências Exatas e da Terra

Instruções

1	Confira se os dados contidos na parte inferior desta capa estão corretos e, em seguida, assine no espaço reservado para isso. Se, em qualquer outro local deste Caderno, você assinar, rubricar, escrever mensagem, etc., será excluído do Exame.
2	Este Caderno contém 5 questões discursivas referentes à Prova da Língua Estrangeira escolhida pelo candidato. Não destaque nenhuma folha.
3	Se o Caderno estiver incompleto ou contiver imperfeição gráfica que impeça a leitura, solicite imediatamente ao Fiscal que o substitua.
4	Será avaliado apenas o que estiver escrito no espaço reservado para cada resposta, razão por que os rascunhos não serão considerados.
5	Escreva de modo legível, pois dúvida gerada por grafia, sinal ou rasura implicará redução de pontos.
6	Só será permitido o uso de dicionário INGLÊS/INGLÊS.
7	Use exclusivamente caneta esferográfica, confeccionada em material transparente, de tinta preta ou azul. Em nenhuma hipótese se avaliará resposta escrita com grafite.
8	Utilize para rascunhos, o verso de cada página deste Caderno.
9	Você dispõe de, no máximo, três horas, para responder as 5 questões que constituem a Prova.
10	Antes de retirar-se definitivamente da sala, devolva ao Fiscal este Caderno.

Assinatura do Candidato: ____

COMPERVE
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

As questões de 01 a 05, cujas respostas deverão ser redigidas EM PORTUGUÊS, referem-se ao texto abaixo.

Enhanced Photoelectrocatalytic Water Splitting at Hierarchical Gd^{3+}:TiO_2 Nanostructures Through Amplifying Light Reception and Surface States Passivation

P. Sudhagar, Anitha Devadoss, K. Nakata, C. Terashima, and A. Fujishima

The photoelectrocatalytic (PEC) water oxidation phenomenon configured with light and semiconductor opens new pathways in cost-effective fuel generation (hydrogen and oxygen) using water as feed stock. Merits counting the zero-emission of harmful CO_2 into environment, possibility of beneficial simultaneous process of pollutant treatment, and/or biomass reformation toward hydrogen fuel generation foster PEC water oxidation as an emerging technology in green energy fuels. Nanostructured titanium dioxide (TiO_2) is one of the most studied candidates in PEC applications including fuel generation, organic pollutant degradation, photoelectrochemical biosensors, photocatalytic self-cleaning coatings and antimicrobial coatings. [...] One of the approaches to promote PEC performance of TiO_2 in solar to fuel generation is extending the visible light activity of TiO_2 by bandgap modification through doping with metal ions (Fe, Ni, V, or Cr), non-metallic elements (N, S, and C) or inducing defects in crystallite lattice. However the doping material perhaps shift the TiO_2 valence band more negative than the water oxidation potential 1.2 V vs RHE, which in turn might affect the PEC water oxidation rates.

The lanthanide (Ln) rare earth ion (RE) doping at TiO_2 matrix is an alternative approach to enhance the light reception at TiO_2. Furthermore, RE ions doping can alter the bandgap structure of host material based on their electronic configuration and thus, may improve the PEC performance toward fuel generation or pollutant degradation. For instance, half-filled 4f electronic configuration of lanthanide (Ln) ions can be filled by host material. Therefore, occupying electronic position of Ln 4f orbital between the valence band (VB) and conduction band (CB) of host material determines their electronic bandgap structure, which predominantly controls the photocatalytic activity of host. Xu et al. performed pollutant dye degradation experiments using a series of rare earth metal ions (Gd^{3+}, Nd^{3+}, La^{3+}, Pr^{3+}, Er^{3+}, Ce^{3+} and Sm^{3+}) doped TiO_2 under UV-Visible light illumination. It is found that gadolinium (Gd^{3+}) ions were more effective in nitride pollutant degradation attributed to enhance the NO_2^- adsorption on TiO_2. Conversely, a half-filled 7f orbital electronic configuration of Gd^{3+} modify the band structure of TiO_2. Abe et al. explored that the gadolinium (Gd^{3+}) ions undergo effective incorporation in TiO_2 matrix and form cubic pyrochlore ($Gd_2Ti_2O_7$). The resultant $Gd_2Ti_2O_7$ electronic structure associate with NiOx co-catalyst resulting in competitive fuel (hydrogen and oxygen) generation compared to $R_2Ti_2O_7$ type PC materials (R = Y, Gd, La, M, Nb, Ta). In theoretical view point (density functional theory), Zhao et al. endorse that Gd^{3+} doped TiO_2 ($Ti_{1-x}Gd_xO_2$) showed significant visible light activity without altering the redox. In our previous work, we explored the structure (nanofiber and nanoparticulate) dependent photocatalytic property of Gd doped TiO_2 mesoporous electrodes toward pollutant organic dye degradation. We found that the enhanced lattice stress of 23.688 GPa at TiO_2 lattice upon Gd^{3+} doping comply lanthanide contradiction law, which facilitated the charge separation at electrode/electrolyte interfaces.

Although the earlier reports explained the advantages of Gd doped TiO_2 modifying the TiO_2 bandgap and promoting photocatalytic activity, the generic mechanism of PEC hydrogen generation in electrode form is not yet explored. In addition, most of the RE doped TiO_2 were studied in suspended photocatalysis type which limits the further development in large-scale fuel production. More importantly, the influence of doping ions at surface states are not discussed as is one of the limiting factor through capturing either photoholes or photoelectrons leading to recombination at electrode/electrolyte interfaces. In this line, for the first time we report the PEC hydrogen generation using Gd^{3+} ions doped TiO_2 mesoporous electrodes and the underlying mechanism of surface states controlled water oxidation process was studied in detail.

Journal of The Electrochemical Society, **162** (3) H108-H114 (2015)

Questão 1

Qual é a importância da aplicação da PEC na água?

Espaço para Resposta

Questão 2

Qual é um dos candidatos mais estudados, citado no texto, para uso como PEC e quais suas aplicações?

Espaço para Resposta

Questão 3

Descreva uma das abordagens para promover o desempenho da PEC em TiO_2.

Espaço para Resposta

Questão 4

Explique o trabalho de Abe et al. com o uso de íons Gd^{3+}.

Espaço para Resposta

Questão 5

- Traduza o fragmento textual abaixo no espaço reservado para isso.
- Seu texto deverá apresentar clareza e estar bem articulado tanto em termos estruturais quanto de sentido.

> *In addition, most of the RE doped TiO_2 were studied in suspended photocatalysis type which limits the further development in large-scale fuel production. More importantly, the influence of doping ions at surface states are not discussed as is one of the limiting factor through capturing either photoholes or photoelectrons leading to recombination at electrode/electrolyte interfaces. In this line, for the first time we report the PEC hydrogen generation using Gd^{3+}ions doped TiO_2 mesoporous electrodes and the underlying mechanism of surface states controlled water oxidation process was studied in detail.*

ESPAÇO DESTINADO AO TEXTO DEFINITIVO