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Photoelectrocatalytic oxidation of moxifloxacin on $NiWO_4$-$CoWO_4$ homojunction photoanode

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Abstract

Advanced Oxidative Processes (AOP) consist of the use of radial hydroxyls (•OH) to completely mineralize organic contaminants such as dyes and drugs, converting them into CO_2 and water. In heterogeneous photocatalysis, TiO_2 is still the most investigated material as it presents advantages that include low cost and high chemical stability. However, TiO_2 has photoactivity only under radiation with $\lambda < 380$ nm. In this context, colored oxides such as cobalt tungstate ($CoWO_4$) and nickel tungstate ($NiWO_4$) become attractive semiconductors as they are capable of absorbing light in the visible region of the spectrum [1]. In addition, semiconductor junction strategy has been used to minimize charge recombination electron-hole [2]. In this work we present the results of studies carried out with films (photoelectrodes) formed by the homojunction of $CoWO_4$ and $NiWO_4$. The n-type behavior of the films allowed their application as a photoanode for oxidation of the antibiotic Moxifloxacin (MOX), a broad-spectrum antibiotic that belongs to the fluoroquinolone class. MOX is used to treat a variety of bacterial infections. However, the presence of MOX as a pollutant in wastewater can promote the emergence of bacteria resistant to this drug. Thus, the removal of MOX by AOP is an alternative to prevent the emergence of superbugs. $CoWO_4$ and $NiWO_4$ oxides deposited as films on FTO-glass were obtained by the polymeric precursor method. XRD measurements revealed that both oxides present a monoclinic phase. The optical characterization showed that the junction of materials shifted the light absorption region to longer wavelengths (Fig. 1a), suggesting greater use of visible light for homojunction film. Chronopotentiometric measurements confirmed the n-type behavior of the material. Film with homojunction of the FTO|$NiWO_4$-$CoWO_4$ showed charge separation superior to the FTO|$CoWO_4$-$NiWO_4$ configuration. Energy band diagram shaped the favorable charge flow for the FTO|$NiWO_4$-$CoWO_4$ junction. This homojunction presented photocurrents of 25 μA cm^{-2} (vs Ag/AgCl) (Fig. 1b). In photoelectrocatalysis, the application of potential to the homojunction electrode favored the charge separation process and increased the MOX removal efficiency, reaching 30% in 180 min (Fig. 1c). This result is superior to those observed for photocatalysis obtained in the absence of potential application (bias potential). Thus, the strategy of combining two colored tungstate semiconductors and the application of an external polarization potential (FHE) proved to be more efficient in treating water contaminated by MOX.

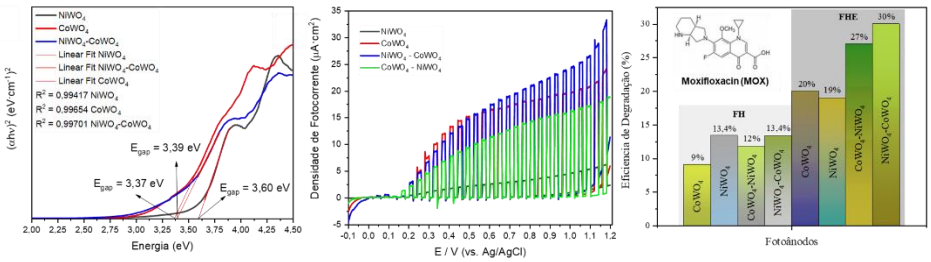

Fig. 1. a) Bandgap energy, b) photocurrent measurements and c) photoelectrocatalytic results of MOX removal for isolates and as homojunction.

Keywords: homojunction, visible light, photoelectrochemical

References

1. Costa, M. J. S., et al. Progesterone photoelectrocatalytic degradation on $NiWO_4$|$CoWO_4$ homojunction film. Catalysis Today, (2024) 442, 114955.

2. Lima, A. E. B. et al. $CuWO_4$|$MnWO_4$ heterojunction thin film with improved photoelectrochemical and photocatalytic properties using simulated solar irradiation. Journal of Solid State Electrochemistry 26 (2022) 997.

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