Artículos Científicos

División Académica de Ingeniería y Arquitectura
ABSTRACT

Some microorganisms can produce biotensoactive when in contact with hydrocarbons, allowing microbial cells to metabolise them effectively. In this study, we evaluated the capacity of nitrogen-fixing (NFB) and hydrocarbonoclastic bacterial strains to generate biotensoactive. The sampling site was in a flood plain of the Chico Zapote River, on the low basin of the Tonalá River in Tabasco, Mexico. Rhizospheres and soil contaminated by oil were collected, and the concentration of oil and botanic samples were determined for their taxonomic classification. The collected rhizosphere oil was seeded into Congo red cultures to obtain Azospirillum (NFB) bacteria. The NFB strain was placed in liquid mineral medium with oil as the only carbon source to identify the hydrocarbonoclastic strains. Biochemical and physiological evaluations determined that the species were Azospirillum brasilense and Azospirillum lipoferum. The strains were placed into Kim medium for generating a biosurfactant. The biosurfactant produced by A. brasilense showed an emulsion stability of 229 min, yield of 0.1375 g L\(^{-1}\), emulsion capacity of 80 % and superficial tension of 38 mN m\(^{-1}\), and while the biotensoactive produced by A. lipoferum had an emulsion stability of 260 min, yield of 0.22 g L\(^{-1}\), emulsion capacity of 90 % and superficial tension of 35.5 mN m\(^{-1}\).

Keywords: Azospirillum; Biosurfactants; Hydrocarbonoclastic bacteria
Mn-doped Zn/Al layered double hydroxides as photocatalysts for the 4-chlorophenol photodegradation


ABSTRACT

Mn-doped Zn/Al layered double hydroxides (LDH) with Mn 0.5-3.0% mol respect to Zn content with improved photocatalytic degradation of 4-chlorophenol (4Clphenol) were studied. The characterization studies showed the isomorphic incorporation Mn as dopant until 1% mol. The 4Clphenol degradation was proposed as result of a combined effect of oxidation by both hydroxyl radicals (OH) and photogenerated holes (h+). In a proposed mechanism it is suggested that Mn enhances the charge separation acting as electron e- (Mn3+: Mn4+) or hole h+ (Mn2+: Mn3+) traps according to its oxidation state. Exhaustive characterization through EDS, XRD, UV-vis-DRS, TEM-Dark field STEM, fluorescence spectroscopy for OH detection and XPS, has been done denoting the importance of the Mn content and its different oxidation states in the photophysical and photocatalytic properties of the Mn-doped Zn/Al-based layered double hydroxides.

Keywords: 4-Chlorophenol degradation; Layered photocatalysts; Mn charge separator; Mn electron trap; Mn hole trap; Reconstructed mn-doped LDH
Numerical study of the effect of buoyancy on conjugate heat transfer in simultaneous turbulent flow in parallel pipelines

<table>
<thead>
<tr>
<th>Serrano-Arellano, J.¹</th>
<th>Riesco-Ávila, J.M.²</th>
<th>Belman-Flores, J.M.²</th>
<th>Aguilar-Castro, K.³</th>
<th>Macías-Melo, E.V.³</th>
</tr>
</thead>
</table>

¹. División de Arquitectura e Ingeniería en Energías Renovables, Instituto Tecnológico Superior de Huichapan
². Universidad de Guanajuato, Comunidad de Palo Blanco,
³. División de Ingeniería y Arquitectura, Universidad Juárez Autónoma de Tabasco

ABSTRACT

This paper presents a numerical study of conjugate heat transfer between two air flows circulating in parallel pipelines. We analysed the buoyancy effect generated by the temperature gradient, by coupling the movement produced by the air flow forced through the entrances of the input ducts. The buoyancy effect favours a rapid transition to turbulence. The governing equations were solved using the finite volume technique. The variables were the Reynolds number in a range from 10 to 1000, and the aspect ratio values of 5, 25, and 50. The results show the importance of buoyancy on the performance of the heat exchanger. Furthermore, it was found that at low Reynolds numbers, buoyancy did not favour heat exchange effectiveness of increasing heat across the length of the channels. Furthermore, when the Reynolds value is 1000, we conclude that heat transfer is not affected by the buoyancy. Therefore, efficiency of heat exchange depends mainly on the length of the channels.

Keywords: Convection; Heat exchanger; Parallel flow; Turbulent flow
NiW/MgO-TiO2 catalysts for dibenzothiophene hydrodesulfurization: Effect of preparation method

Pérez, A.E.C.¹, Torrez Jiménez, Y.¹, Velasco Alejo, J.J.¹, Zepeda, T.A.², Frías Márquez, D.M.¹, Rivera Ruedas, M.G.¹, Fuentes, S.², De León, J.N.D.²

1. División Académica de Ingeniería y Arquitectura, Universidad Juárez Autónoma de Tabasco,
2. Universidad Nacional Autónoma de México, Centro de Nanociencias y Nanotecnología

ABSTRACT

In the present work NiW-based catalysts supported on binary MgO-TiO2 mixed oxides (MT-x, were x is the mol% of TiO2) were prepared by aqueous and non-aqueous methods. The results from the characterization techniques (N2 adsorption/desorption, XRD, UV-vis DRS and HRTEM) were used to establish a relationship between the preparation method and the structural changes of W phases as well the catalytic activity. N2 adsorption/desorption isotherms showed higher surface areas with the increase on mol% of TiO2. Catalysts characterization showed that the preparation method did not change the original structure of the supports. Furthermore, the presence of NiO and NiWO4 was not observed in any sample, thus, the supports allowed a good dispersion of Ni and W species. DRS spectra showed the presence of W6+ in octahedral coordination and tetrahedral Ni2+. Correlation of the catalytic activity in the DBT HDS reaction and the fraction of W atoms on the edge of WS2 crystallites indicated that the aqueous impregnation on MT25, followed by drying at 393 K leads to the formation of a greater number of catalytically active sites available for interaction with DBT molecules.

Keywords: Active phases; Dibenzothiophene; Hydrodesulfurization; MgO-TiO2 mixed-oxides; WS2-crystallites
Effect of surface modification on the bioactivity of sol–gel TiO2-based nanomaterials

Mayra A Alvarez Lemus1, Hugo Monroy2, Tessy López3, Erick N De la Cruz Hernández4 and Rosendo López-González1

1. División Académica de Ingeniería y Arquitectura, Universidad Juárez Autónoma de Tabasco
2. Departamento de Biología, CINVESTAV-Zacatenco.
3. Universidad Autónoma Metropolitana-Xochimilco.
4. División Académica Multidisciplinaria de Comalcalco, Universidad Juárez Autónoma de Tabasco, Mexico.

ABSTRACT
BACKGROUND: Surface composition of titanium dioxide (TiO2) nanoparticles strongly affects their biocompatibility and cytotoxicity. The appropriated functionalization of TiO2 nanoparticles leads to the improvement of these properties; while increasing biocompatibility allows the safety use of TiO2 nanoparticles, their cytotoxicity can be properly used in cancer therapy.

RESULTS: Amine functionalization of the sol–gel TiO2 nanoparticles was performed by in situ addition of Gama-aminobutyric acid (GABA)-, and 1% mol of platinum (II) acetylacetonate. Fluoresceine isothiocyanate (FITC) was attached to the surface of the nanoparticles through amine-groups from GABA on the titanium dioxide surface. Nanoparticles obtained formed aggregates of around 100–300 nm. A strong and steady green-emission from labeled nanomaterials was observed. Transmission electron microscopy (TEM) showed that smaller particles (<100 nm) passed through the cellular membrane as they were observed within the cytoplasm and mitochondria. Activation of Caspase-3, a protein involved in apoptosis, was observed in treated cells, which agrees with terminal deoxynucleotidyl transferase dUTP nick end labeling assay results (TUNEL) where the highest DNA fragmentation was observed for Pt-TiO2-GABA nanomaterial.

CONCLUSIONS: TiO2 amino-functionalized nanoparticles were fluorescently labeled in a simple manner. The nanoparticles formed vesicles and activated a caspase-3 mediated mechanism to induce apoptosis. The addition of acetylacetone together with platinum promoted cell death.

Keywords: titanium dioxide; aminobutyric acid; platinum (II) acetylacetonate; SH-SY5Y cell line; xerogel; neuroblastoma
Biosurfactant Synthesized by *Azospirillum lipoferum* ALM1B2: Characterization and Application for Environmental Protection

Marcia E. Ojeda-Morales ¹, Marivel Domínguez-Domínguez ¹, Miguel A. Hernández-Rivera ², Juan G. Álvarez-Ramírez ²

¹ Colegio de Postgraduados, Campus Tabasco.
² Universidad Juárez Autónoma de Tabasco-División Académica de Ingeniería y Arquitectura.

**ABSTRACT**

This study characterizes a biotensoactive produced by the bacterium *Azospirillum lipoferum*, which was isolated from the rhizospheres of contaminated plants with oil in the lower basin of the Tonala River, Villa Benito Juarez, municipality of Cardenas, Tabasco, Mexico. The following properties were analyzed: viscosity at 25 °C, elemental analysis (% mol) by scanning electron microscopy, density at different temperatures, molecular weight, acute toxicity, median lethal concentration (LC₅₀), and saponification and acidity indices. The effects of pH (6.0, 7.0, 8.0, and 9.0) and temperature (25, 30, 35, and 40 °C) on the production of the biotensoactive and the effect of NaCl on the surface tension, density, and emulsifying capacity were studied. The results showed that the viscosity remained stable between 1.0914 and 1.1276 mPa-s, so the biotensoactive was classified as low-molecular weight. Toxic effects on the population of *Eisenia fetida* began at surfactant concentrations above 55,000 ppm, and the LC₅₀ was 96,695 ppm. The highest yield of biotensoactive production was obtained 48 h after the beginning of the treatment at pH 8 and pH 9 and 25 °C. At 25 °C, the surface tension ranged from 44.60 mN/m at a 1 % concentration by weight of NaCl to 51.11 mN/m at 15 % NaCl, while at 60 °C, the surface tension ranged from 34.90 mN/m at 1 % NaCl to 40.22 mN/m at 15 % NaCl. The emulsifying capacity was 70 % (aqueous solution 15 % NaCl).

Keywords: *Azospirillum* Hydrocarbons Surface tension Characterization Toxicity
Suitable preparation of Bi2S3 nanorods –TiO2 heterojunction semiconductors with improved photocatalytic hydrogen production from water/methanol decomposition

García-Mendoza, C.¹, Oros-Ruiz, S.¹, Hernández-Gordillo, A.², López, R.³, Jácome-Acatitla, G.¹ Calderón, H.A.⁴, Gómez, R.¹

| ¹. Universidad Autónoma Metropolitana-Iztapalapa, | 1. Universidad Autónoma Metropolitana-Iztapalapa, |
| ². Instituto de Investigaciones en Materiales, | 2. Instituto de Investigaciones en Materiales, |
| Universidad Nacional Autónoma de México, | Universidad Nacional Autónoma de México, |
| Universidad Juárez Autónoma de Tabasco, | Universidad Juárez Autónoma de Tabasco, |
| División Académica de Ingeniería y Arquitectura, | División Académica de Ingeniería y Arquitectura, |
| ³. Universidad Juárez Autónoma de Tabasco, | ³. Universidad Juárez Autónoma de Tabasco, |
| ⁴. Departamento de Física ESFM-Instituto | ⁴. Departamento de Física ESFM-Instituto |
| Politécnico Nacional, | Politécnico Nacional, |

ABSTRACT

BACKGROUND: Hydrogen, as a clean and renewable energy source has become very attractive due to the deterioration of the global environment. In this way photocatalytic water-splitting for H2 production using light energy in the presence of semiconductors capable of absorbing such irradiation has become a promising approach for generation of H2. The intensity of incident solar energy on the earth’s surface is 1000 W m–2 and only 4% of the total solar energy corresponds to UV light (40 W m–2), but this could be sufficient for H2 production from water splitting with very efficient semiconductors using the UV solar energy radiation.

RESULTS: The synthesis of Bi2S3 –TiO2 composites using TiO2 sol–gel (3, 6 and 9 Bi2S3 wt%) was performed by a solvothermal method and these materials were evaluated under UV light irradiation (254 nm, 2 W) for photocatalytic hydrogen production from a water/methanol solution. The optimal loading was obtained for the Bi2S3 –TiO2 composite at 6 wt% showing a production of 2460 µmol h–1 g–1 of hydrogen, increasing by a factor of 4 the production of bare TiO2 at 564 µmol h–1 g–1. The Bi2S3 –TiO2 composite presented good stability after three complete cycles of reaction, proving resistance to corrosion effects.

CONCLUSION: Bi2S3 –TiO2 presented a higher photocatalytic activity than bare TiO2 for an optimal content of 6 wt% Bi2S3 –TiO2 . This improvement is attributed to enhanced absorption in the UV-Vis region of the Bi2S3 –TiO2 composite, and a higher transference of the charge carriers in the Bi2S3 –TiO2 heterojunctions with a hindered recombination e–/h+.

Keywords: Bi2S3 nanorods; TiO2; hydrogen production; heterojunction; photocatalysis
Departamento de Fortalecimiento de Grupos de Investigación

Dirección:
Av. 27 de Febrero 626, Col. Centro, C.P. 86000, Villahermosa, Tabasco, México.

Contacto:
Tel. (993) 358.15.00 Ext. 5012.
E-mail: fortalecimiento.investigacion@ujat.mx