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**Biosurfactant Production by Strains of
Azospirillum Isolated from Petroleum-
Contaminated Sites**

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ABSTRACT

Some microorganisms can produce biotensioactive when in contact with hydrocarbons, which favours micelle formation, allowing microbial cells to metabolise them effectively. In this study, we evaluated the capacity of nitrogen-fixing (NFB) and hydrocarbonoclastic bacterial strains to generate biotensioactive. 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 biotensioactive 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



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Mn-doped Zn/Al layered double hydroxides as photocatalysts for the 4-chlorophenol photodegradation

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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



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Numerical study of the effect of buoyancy on conjugate heat transfer in simultaneous turbulent flow in parallel pipelines

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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



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NiW/MgO-TiO₂ catalysts for dibenzothiophene hydrodesulfurization: Effect of preparation method

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ABSTRACT

In the present work NiW-based catalysts supported on binary MgO-TiO₂ mixed oxides (MT-x, where 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



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Effect of surface modification on the bioactivity of sol-gel TiO₂-based nanomaterials

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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



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Biosurfactant Synthesized by *Azospirillum lipoferum* ALM1B2: Characterization and Application for Environmental Protection

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ABSTRACT

This study characterizes a biotensioactive produced by the bacterium *Azospirillum lipoferum*, which was isolated from the rhizospheres of contaminated plants with oil in the lower basin of the Tonalá River, Villa Benito Juárez, 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 biotensioactive 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 biotensioactive was classified as low-molecular weight. Toxic effects on the population of *Eisenia foetida* began at surfactant concentrations above 55,000 ppm, and the LC₅₀ was 96,695 ppm. The highest yield of biotensioactive 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



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Suitable preparation of Bi₂S₃ nanorods –TiO₂ heterojunction semiconductors with improved photocatalytic hydrogen production from water/methanol decomposition

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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



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