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SOLID OXIDE FUEL CELL CATHODES STUDY AND PERFORMANCE OPTIMIZATION

The Solid Oxide Fuel Cells(s) cathode made of Lanthanum-Strontium-Cobalt-Ferric Oxide (LSCF) was prepared using the Sol-Gel (SG) method, followed by heating at 900ºC, this temperature was maintained for 4 hrs. The kinetics of the oxygen reduction reaction (ORR) on the cathode compartment was investigated using electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV) at operating temperatures of 600 and 700ºC respectively. The results indicated that the SG-derived LSCF cathode exhibited long-term stability and a faster reaction rate at intermediate temperature range. The Microstructure characterization of LSCF cathode displayed that the highly-crystallized LSCF cathode material was obtained and its phase structure was indexed with the tetragonal perovskite (JCPDS No. 48-0125). The particles of the cathode were monodispersed and the cathode was highly porous which enhanced the oxygen gas diffusion. In order to optimize the fabrication and measurement variables, artificial neural network (ANN) was applied in this research.

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DEVELOPMENT OF AN ON-LINE CLEAN-UP METHOD FOR EXTRACTION OF TWO ANTI-CANCER DRUGS FROM SERUM

An on-line solid phase extraction (SPE) method has been developed for the determination of doxorubicin and paclitaxel in blood serum. A number of solid phases were investigated off-line for their ability to extract both chemotherapy drugs from serum using a single set of conditions and the best recoveries were obtained using Strata-X material. This is the first on-line SPE method reported for this combination of cancer drugs. The extraction method gives at least as good recoveries as current off-line liquid-liquid extraction procedures and the overall SPE-LC assay is much faster than current analytical protocols. With further optimisation, this method may offer a simple, fast way of monitoring levels of both drugs simultaneously in patients during chemotherapy.

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SYNTHETIC FUELS AND BIOFUELS: QUESTIONABLE BLENDING STOCKS FOR PETROLEUM

As the price of petroleum-derived middle distillate fuels continues to spiral upward, the search for suitable replacements or blending stocks is earnestly continuing. Renewable agricultural crops such as soybeans and others are now in the forefront. Non-renewable materials such as scrap tires and recycled plastics as well as synthetic fuels such as those produced by a Fischer-Tropsch process have also been suggested. It is probable that several of these materials could be simultaneously blended into a middle distillate petroleum based diesel fuel. Care must be employed when blending fuels so that fuel specifications and fuel stability are not decreased. The Department of Defense is considering allowing up to five percent biofuel in any diesel fuel purchased. This paper compares a Fischer-Tropsch (FT) diesel with a petroleum diesel both blended with a 5% and 10% soy–biodiesel fuel.

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LOW-MOLECULAR-WEIGHT-CHROMIUM-BINDING SUBSTANCE (LMWCR) FROM *OCTOPUS VULGARIS* LIVER

Low-molecular-weight chromium-binding substance (LMWCr) also named chromodulin has been shown to bind to the insulin receptor in response to insulin and increase the ability of insulin to signal cells when glucose concentrations in the blood are high. This material may be related to adult-onset diabetes, where body tissues become insensitive to insulin. Our laboratory has used liver from the common brown octopus, octopus vulgaris and an *in vitro* chromium loading procedure to isolate LMWCr. The results of the isolation procedure, spectroscopic characterization, biological activity, and a comparison with other chromodulins will be presented.

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STUDY OF HETEROGENEOUS BASE CATALYSTS FOR BIODIESEL PRODUCTION

Solid metal oxides were tested as heterogeneous base catalyst for the production of biodiesel fuel derived from virgin and waste vegetable oil feedstocks. Compounds tested included MgO, CaO, SrO, and BaO. The most effective catalyst was 1.0 mol% BaO which showed >95% conversion of canola oil to biodiesel in 1 hour at 50°C. The relative order of effectiveness was BaO ~ SrO > NaOH >> CaO ~ MgO. The SrO catalyst was studied further due to toxicity concerns with BaO. Catalyst recovery was difficult and conversion efficiency dropped to 38% on re-use of the SrO. Further testing of silica and alumina as solid supports for SrO did not improve recoverability or conversion efficiency. The experimental results suggest a different paradigm such as solid acid catalysts may provide a more fruitful approach for the heterogeneous transesterification of vegetable oils to biodiesel.

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QUANTUM CHEMISTRY CALCULATIONS OF METHYL AND DIMETHYLCYCLOBUTADIENE

Lowering the symmetry of the ring for cyclobutadiene by the addition of methyl groups, as for methyl-cyclobutadiene and dimethyl-cyclobutadiene increases the energy difference between the rectangular-singlet and square-triplet conformers from 25 $kJmol^{-1}$ to 31-195 $kJmol^{-1}$. There are three distinct isomers for dimethyl-cyclobutadiene differing by the placement of the methyl groups about the ring. The lowest energy isomer is the 1,3- form followed by 1,4- and then 1,2-dimethyl-cyclobutadiene. The 1,4- isomer distorts to lower the interaction between the two methyl groups by adopting a slightly trapezoidal ring geometry. 1,2- also distorts but to a much lesser extent.

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FLUORESCENCE AND SINGLET OXYGEN QUANTUM YIELDS OF SULFONATED METAL-PHTHALOCYANINES

Two sulfonated metal-phthalocyanines were evaluated for their potential to serve as photosensitizers in photodynamic detection (PDD) and photodynamic therapy (PDT). Their relative fluorescence quantum yields were measured by the gradient method and compared using two different standards. An indirect measure of singlet oxygen, O_2 ($^1\Delta_g$), was accomplished by the iodide method. Tetrasulfonic acids of aluminum phthalocyanine chloride ($AlPcS_4$) and zinc II phthalocyanine ($ZnPcS_4$) were compared to Rose Bengal (RB) for O_2 ($^1\Delta_g$) quantum yields. $AlPcS_4$ exhibits a substantially greater O_2 ($^1\Delta_g$) quantum yield than either $ZnPcS_4$ or RB. The fluorescence quantum yields for both metal-phthalocyanines were comparable, and each may be considered for PDD applications. However, $ZnPcS_4O_2$ induced O_2($^1\Delta_g$) quantum yield was too low to be a suitable photosensitizer for PDT.

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