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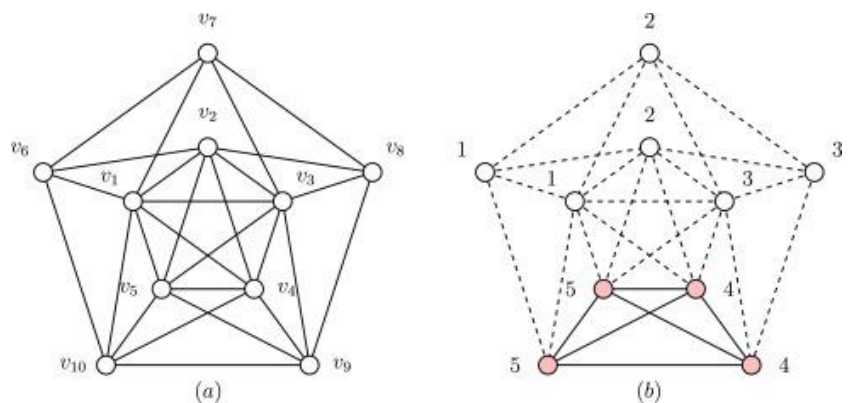
<http://www.etsidi.upm.es/Investigadores/ActivYpublicacDeInvestigacion/BoletinETSIDI>

Este boletín informativo electrónico de periodicidad bimestral tiene como objetivo informar de las actividades de investigación desarrolladas en la ETS de Ingeniería y Diseño Industrial y recopilar los resúmenes de los artículos publicados en la Web of Science (WoS) de los que son autores o coautores investigadores de la Escuela.

PUBLICACIONES.

A new branch-and-bound algorithm for the Maximum Weighted Clique Problem.

We study the Maximum Weighted Clique Problem (MWCP), a generalization of the Maximum Clique Problem in which weights are associated with the vertices of a graph. The MWCP calls for determining a complete subgraph of maximum weight. We design a new combinatorial branch-and-bound algorithm for the MWCP, which relies on an effective bounding procedure. The size of the implicit enumeration tree is largely reduced via a tailored branching scheme, specifically conceived for the MWCP. The new bounding function extends the classical MWCP bounds from the literature to achieve a good trade off between pruning potential and computing effort. We perform extensive tests on random graphs, graphs from the literature and real-world graphs, and we computationally show that our new exact algorithm is competitive with the state-of-the-art algorithms for the MWCP in all these classes of instances.



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Mitigation of price spike in unit commitment: A probabilistic approach.

During the last decade, electricity markets regulators in Latin American countries have been concerned about the increasing costs of electrical energy. To this end, regulatory changes have been introduced to develop new criteria for price sanction, which demonstrates the need to study this problem at the fundamental level. Until now, the alternatives proposed and implemented have been aimed at modifying the way in sanctioning short-term energy prices, moving away from the rigorous application of the marginal cost theory. This situation can be considered as the evidence that the characteristics of Latin American electricity markets differ significantly from the ideal conditions that are necessary for the application of this conceptual framework. This paper presents a methodology for establishing a metric for energy tariffs risk which is used in a procedure to mitigate price spikes in the process of the Short-Term Operational Planning (Unit Commitment). The proposed methodology considers the most widely-used mechanisms for the sanction of real-time (spot) market prices in Latin America, which are based on the variable production costs. The results from the application of this methodology to a test power system with hydrothermal and non-conventional (wind) energy resources show an effective reduction of price volatility.

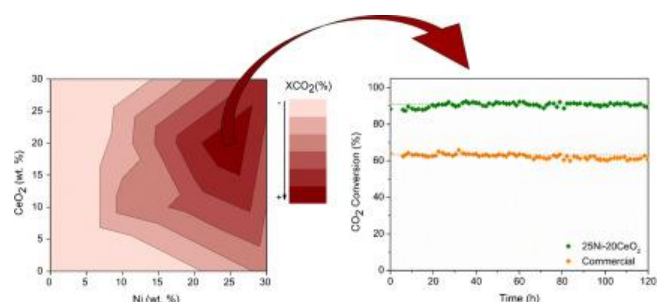
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Optimization of nickel and ceria catalyst content for synthetic natural gas production through CO₂ methanation.

Manufacturing of catalysts with high reaction rates at mild conditions is important for an efficient production of synthetic natural gas through the CO₂ methanation process. In this work, the design of a technical catalyst based on an optimal content of Ni as active phase, CeO₂ as promoter and gamma-Al₂O₃ micro-spheres as support (d(p) = 400-500 pm) is evaluated. The systematic optimization of Ni, CeO₂ and gamma-Al₂O₃ content revealed that a proper balance of the positive effects that each component provided individually, was found at 25 wt% Ni, 20 wt % CeO₂ and 55 wt% gamma-Al₂O₃ content. This catalyst was stable for 120 h at 300 degrees C. The high loading of CeO₂ is far from the classical definition of promoter and it covers the gap between the addition in a low amount as promoter and its uncompetitive use as bulk support. The highest catalytic activity was attributed to high metallic surface area (5 m².g(-1)), high nickel reducibility (79% at 500 degrees C) and the formation of moderate basic sites that can adsorb CO₂ (-65 kJ.mol(CO₂)(-1)). In comparison with similar research catalysts and a commercial reference, the optimum formation showed higher activity for synthetic natural gas production. Therefore, the micro-catalyst can be implemented in the micro-structured reactors that are available in the market.



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How does a flipped classroom course affect the affective domain toward science course?

Teaching science in higher education has traditionally consisted of delivering knowledge as lectures to students following a teacher-centered methodology. The flipped methodology known as inverted instruction can be used as an alternative approach providing a student-centered class. This contribution presents a comparison of two different instruction methodologies, Traditional Instruction Methodology (TIM) and Inverted Instruction Methodology (IIM), in terms of students' perceptions and emotions in a science course. The results after applying various data analytics showed that the IIM had a significant influence in students' perceptions toward the course and made classes more interactive. Besides, the IIM had a positive impact in students' emotions self-reported during the course. In fact, the IIM made a promotion of positive emotions toward the course, particularly when students did not have a prior science educational background. That is especially relevant since the majority of students enrolled had not taken science subjects in the previous educational levels.

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Spectroscopic estimation of plasma parameters, in the 100-400ns stage, of a laser-induced plasma in vacuum.

This work is focused on the interpretation of the emission spectra in laser-induced plasma observed in the phase at 100-400ns from after the laser pulse, when the discrete emission lines prevail on the continuum emission, can be important to retrieve the initial stage of expansion. A Q-switched neodymium-doped yttrium aluminum garnet laser has been used for the ablation of a lead sample in vacuum. The observed line profiles, corresponding to different species of lead, were analyzed in terms of delay time. Measurements of parameters of the produced plasmas are performed. The results obtained corroborate the importance of considering nonequilibrium effects in the initial stage of plasma expansion. Also, Stark width for two spectral lines of triply ionized lead is given.

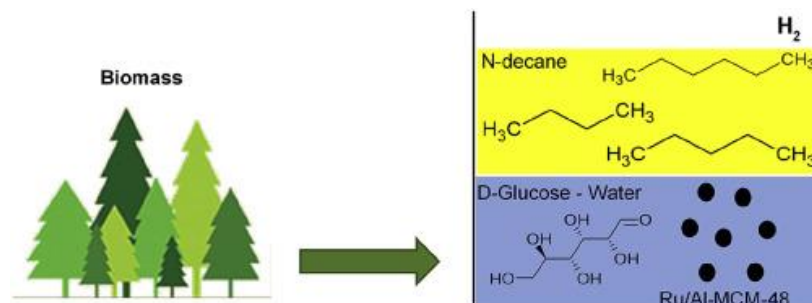
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Improving conversion of D-Glucose into short-chain alkanes over Ru/MCM-48 based catalysts.

The production of fuels from biomass is a key factor for sustainability. With this aim, we have studied the conversion of D-Glucose into short-chain alkanes in a one-pot biphasic catalytic system, evaluating different modifications of Ru/MCM-48: Ru/Al-MCM-48 and Ru/MCM-48 with the addition of tungstophosphoric acid, and compared with a commercial Ru/C. Additionally, different combinations of the previous were studied.



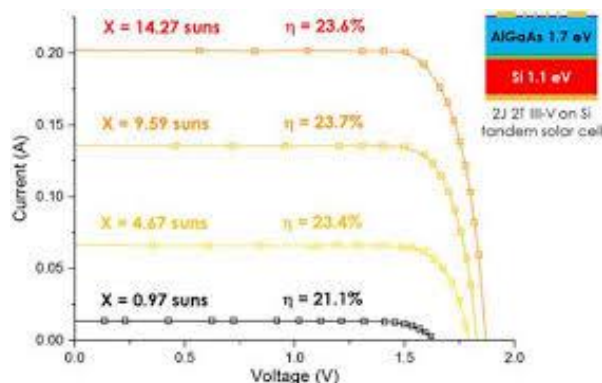
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Characterization of dual-junction III-V on Si tandem solar cells with 23.7% efficiency under low concentration.

Monolithic two-terminal III-V on Si dual-junction solar cells, designed for low concentration applications, were fabricated by means of surface-activated direct wafer bonding. The III-V top cell is a heterojunction formed by an n-Ga0.5In0.5P emitter and a p-Al0.2Ga0.8As base. An efficiency of 21.1 +/- 1.5% at one sun and 23.7 +/- 1.7% at 10 suns is demonstrated, which to our knowledge is the best dual-junction two-terminal III-V on Si tandem cell efficiency reported to date under verified reference conditions. The I-V characterization of these 1-cm(2) tandem cells under concentration required the development of a new method using a single-source multiflash solar simulator and not perfectly matched component cells, also known as pseudo-isotypes, formed by Si single-junction cells and optical filters. In addition, the spectrum of the pulsed solar simulator was measured using a high-speed CMOS spectrometer, allowing the calculation of the spectral mismatch correction factor. Merging these two techniques results in the hybrid corrected pseudo-isotype (HCPI) characterization method, which shows a fast and accurate performance with a simplified procedure based on a single-source solar simulator. Pseudo-isotypes are easily adaptable to new cell designs by simply using a different filter, hence allowing the characterization of new multijunction solar cell architectures.



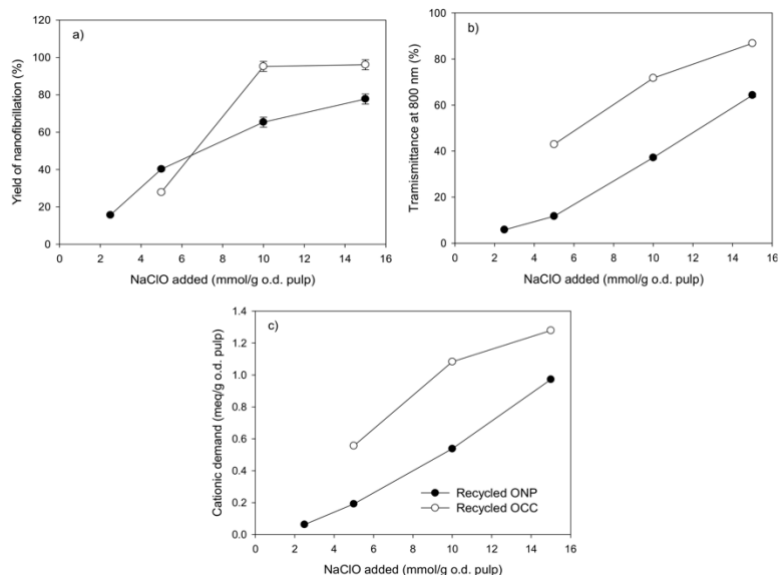
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In Situ Production and Application of Cellulose Nanofibers to Improve Recycled Paper Production.

The recycled paper and board industry needs to improve the quality of their products to meet customer demands. The refining process and strength additives are commonly used to increase mechanical properties. Interfiber bonding can also be improved using cellulose nanofibers (CNF). A circular economy approach in the industrial implementation of CNF can be addressed through the in situ production of CNF using side cellulose streams of the process as raw material, avoiding transportation costs and reducing industrial wastes. Furthermore, CNF fit for use can be produced for specific industrial applications. This study evaluates the feasibility of using two types of recycled fibers, simulating the broke streams of two paper machines producing newsprint and liner for cartonboard, to produce in situ CNF for direct application on the original pulps, old newsprint (ONP), and old corrugated container (OCC), and to reinforce the final products. The CNF were obtained by 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO)-mediated oxidation and homogenization at 600 bar. Handsheets were prepared with disintegrated recycled pulp and different amounts of CNF using a conventional three-component retention system. Results show that 3 wt.% of CNF produced with 10 mmol of NaClO per gram of dry pulp improve tensile index of ONP similar to 30%. For OCC, the same treatment and CNF dose increase tensile index above 60%. In both cases, CNF cause a deterioration of drainage, but this effect is effectively counteracted by optimising the retention system.



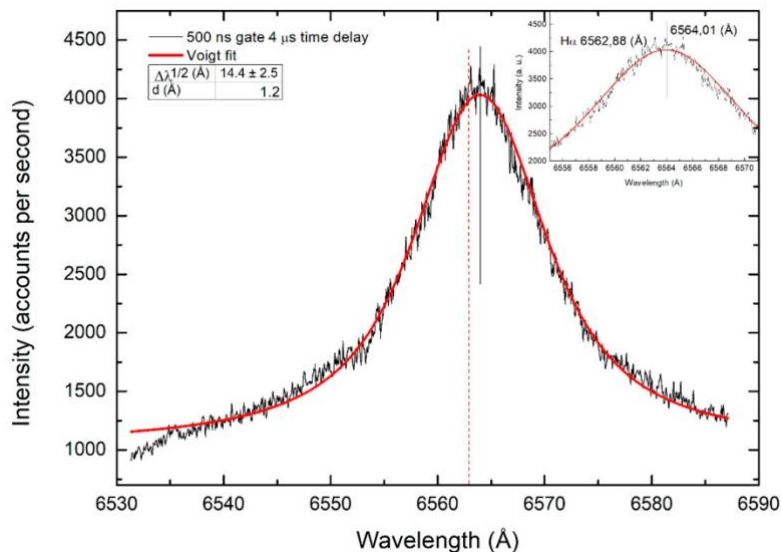
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Experimental Determination of Electronic Density and Temperature in Water-Confined Plasmas Generated by Laser Shock Processing.

In this work, diagnoses of laser-induced plasmas were performed in several Laser Shock Processing (LSP) experiments using the Balmer H β -line (656.27 nm) and several Mg II spectral lines. A Q-switched laser of Nd: YAG was focused on aluminum samples (Al2024-T351) in LSP experiments. Two methods were used to diagnose the plasma. The first method, which required two different experiments, was the standard for establishing the electronic temperature through the use of a Boltzmann Plot with spectral lines of Mg II and self-absorption correction. The Stark width of the Balmer H β -line was used to determine the electron density in each of the cases studied. The second method had lower accuracy, but only required an experimental determination. Two parameters, the electronic temperature and the electron density, were obtained with the aid of the H β -line in a single data acquisition process. The order of magnitude of the temperature obtained from this last method was sufficiently close to the value obtained by the standard method (within a factor lower than 2.0), which is considered to be important in order to allow for its possible use in industrial conditions.



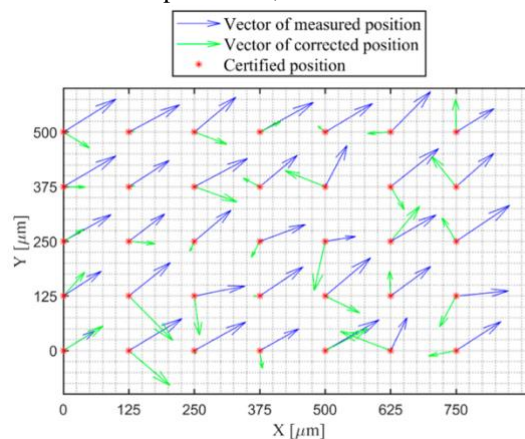
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Characterization and Correction of the Geometric Errors in Using Confocal Microscope for Extended Topography Measurement. Part I: Models, Algorithms Development and Validation

This work presents a method for characterizing and correcting the geometric errors of the movement of the lateral stage of Imaging Confocal Microscope (CM) in extended topography measurement. For an extended topography measurement, a defined number of 2D images are taken and stitched by correlation methods. Inaccuracies due to linear displacement, vertical and horizontal straightness errors, angular errors, and squareness errors based on the assumption of the rigid body kinematics are described. A mathematical model for the scale calibration of the X- and Y- coordinates is derived according to the system kinematics, the axis chain vector of CM, and the geometric error functions and their approximations by Legendre polynomials. The correction coefficients of the kinematic modelling are determined by the measured and certified data of a dot grid target standard artefact. To process the measurement data, algorithms for data partitions, fittings of cylinder centers, and determinations of coefficients are developed and validated. During which methods such as form removal, K-means clustering, linear and non-linear Least Squares are implemented. Results of the correction coefficients are presented in Part II based on the experimental studies. The mean residual reduces 29.6% after the correction of the lateral stage errors.



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Evaluation of isolated sewage treatment systems in Nicaragua.

For some time, interesting projects have been undertaken to treat wastewater in isolated rural areas through low-cost facilities, which allow improved quality access to service for most of the population without economic resources. The present work addresses the problem of access to family sanitation from a low cost technological perspective with the integration of actors: beneficiaries, local operators, National Institutions, University, and International Development Cooperation Organizations. This article presents the analysis of the technologies implemented, integrated and socially accepted in Local Projects and International Programs in Nicaragua: The Rural Cup and the Popular Ecological Toilet. After evaluating its operation from an applied approach, proposals for analysis are presented, highlighting recurrent issues in the implementation of low cost technologies such as the need to implement processes of dissemination, technology transfer and knowledge democratization.



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