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Two nickel thiosemicarbazone-dithiolene complexes for photocatalytic hydrogen evolution in the presence of CdTe quantum dots

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Abstract

The global need to reduce the carbon footprint and switch to greener energy resources has made hydrogen gas (H_2) a promising alternative to be used as fuel.[1] Hydrogen can be produced from the reduction of water while its combustion solely emits water as a by-product too. This procedure forms the basis of a circular economy for environmentally friendly energy production. Photocatalytic hydrogen evolution is a biomimetic process that uses visible light to split water into hydrogen. To reproduce such an artificial photosynthesis (AP) system, a photocatalyst, a photosensitizer with absorption in the visible region, an electron donor, and water are necessary.[2] Inspired by biological catalysts, such as [NiFe] hydrogenases, many complexes containing Ni-S or Ni have been designed to imitate this natural catalytic activity.[3,4] Nickel is seen as a cheap and easily accessible metal that belongs to the platinum group and creates efficient catalysts to be used for hydrogen generation.[5] Moreover a range of various non-innocent ligands attached to a nickel-metal centre represent this kind of biomimetic catalysts with excessive activity in hydrogen production.[6].Herein we report two Ni (II) complexes, which come to complement the long-term research work of our laboratory, in artificial photosynthesis systems for hydrogen evolution.[8,9]A homoleptic Ni(II)-thiosemicarbazone complex and a novel heteroleptic Ni(II)-thiosemicarbazone combined with a dithiolene ligand were studied, in the presence of semiconducting quantum dots (CdTe-TGA) as photosensitizers, for their photocatalytic activity in different ratios and solvents under visible light radiation.

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Application of the 5-parameter model for photovoltaic elements in panels with inhomogeneous distribution of solar radiation

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Abstract

In this work, we analyzed the operation of the photovoltaic panel under different conditions of solar radiation intensity and temperature. This research consists of two main parts. The experimental part involved carrying out a series of measurements and tests on a photovoltaic panel under controlled artificial lighting conditions, both with shading and without shading. The research was conducted at the Energy and Environmental Requirements laboratory of the Evripos complex of the National and Kapodistrian University of Athens. The other part involves simulations of the experimental measurements using the 5-parameter model, which was developed in the MATLAB environment.

The reason we engaged in this research, was to address the low performance of photovoltaic systems under conditions of partial or total shading. Our aim was to propose an improved 5-parameter model, and we present the results of our simulations. For this research, we performed measurements using a system that simulates real conditions, including solar radiation, temperatures and shading, at various tilt angles of panel. We then compared the modeling results between the classic 5-parameter model and our improved model (5 parameters), expecting better performance under extreme conditions.

In the first chapter of the paper, we examined the structure of photovoltaic systems used for electricity production. We introduced the 5-parameter model, which is a way to describe the performance of a PV panel under various conditions, which we used in our simulations. Finally, we presented the basic types of photovoltaic systems.

In the second chapter, we present the experimental setup and the technique we used to record the radiation through a thermal camera. We provide detailed radiation tables for shaded and non-shaded conditions. Tests were performed for each condition at three different angles (0, 4,5 and 9 degrees). Additionally, we present the I-V and P-V curves and compare them with the curves from the first cycle of measurements and simulations.

The third chapter presents the conclusions obtained from the comparison between the classic 5-parameter model and the improved 5-parameter model are presented. Appendices A and B present the equipment and tools used in the experimental part, as well as the tables of the measurements for the shaded and non-shaded conditions and the different angles.

Finally, appendix C presents the MATLAB code.

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A Membrane-less Alkaline High pressure Electrolyzer

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Abstract

The traditional technology of hydrogen generation using water electrolysis has a number of serious drawbacks, which at the present stage significantly slow down the development of hydrogen power engineering. These disadvantages primarily include the need to use the separating ion-exchange membranes between the electrodes in alkaline electrolyzers and the need to use the critical raw materials (platinum group metals and rare earth elements). Separating membranes do not allow high-pressure gas generation, which results in the need to use the complex and expensive compressor equipment to fill gas storage tanks, as well as results in additional energy consumption during gas generation and storage.

The Ukrainian scientists have developed a new concept of membrane-less alkaline high-pressure electrolyzer [1].

This electrolyser is based on the use of an innovative technology of separate generation of hydrogen and oxygen in alternating cycles, which physically excludes mixing of the two gases. The absence of separating ion-exchange membranes in the electrolyzer design increases the specific performance and practically removes the limitations on the pressure of gases in the working area. The pressure of the generated gases is limited only by the strength of the working capacities of the electrolyzer. This technology does not require the use of platinum and rare earth metals and any catalytic materials, it greatly simplifies the design of the electrolyzer and allows to completely abandon the compressing equipment in the system of

gases generation and storage. These advantages allow reaching and exceeding the most important prospective parameters of alkaline electrolyzers.

The technology for generating hydrogen and oxygen by the high-pressure membrane-less electrolyzer has passed a full cycle of testing on the laboratory samples of low productivity (up to 1m^3/h) and just now it is at the stage of preparation and optimization of the technical solutions that are necessary for the industrial application of this technology [6].

Reversible electrolyzers, to be developed in the future based on the technology of the membrane-less high pressure electrolyzer, will provide the opportunity for creating the energy complexes designed for operational balancing of energy in the industrial networks under sharp increase in energy consumption or under sharp decrease in energy generation by wind and solar stations [5].

The development of the proposed technology for the industrial hydrogen production makes it possible to start a practical solution of the problems of power supply to the Lunar Base, which is being created within the framework of the pan-European programs, as well as makes it possible in the near future to solve the problems of obtaining the rocket fuel on the lunar surface.

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Detection of post-fire soil contamination using inductively coupled plasma-mass spectrometry (ICP-MS) in wildfire affected areas in Greece

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Abstract

Fires in urban and natural ecosystems cause catastrophic consequences on a global scale. Concern is raised as it has been observed that the remaining materials after the fire, contain metals, including heavy metals in high or toxic levels[1]. The aim of the present research is to investigate the influence of urban fires on the concentration of mobile forms of such elements of concern and heavy metals in surface and in different soil depths. Sampling of soils of pyrogenic origin was carried out in 2022. At least 800 different ground sampling points were selected according to operating standards in the territory of Mati and Kineta (Attica, Greece). Both suffered from wildfires in July of 2018. The heavy metals content of the soil samples was identified after Aqua Regia extraction. Inductively coupled plasma-mass spectrometry (ICP-

MS) was used as analytical method [2]. Due to its high sensitivity and low detection limit twelve metals were measured (i.e., Al, Cr, Mn, Co, Ni, Cu, Zn, As, Cd, Sn, Hg, Pb). Certified Reference Materials (CRM) were used for the method development. The results were evaluated using the Dutch List, a collection of values and regulations related with the contaminated soils[3].

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Διάβρωση και φθορά σε εξοπλισμό εργοστασίων της ΔΕΗ- Case Studies

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Abstract

Η διάβρωση και η φθορά αποτελούν σημαντικές αιτίες αστοχιών στον παραγωγικό εξοπλισμό της ΔΕΗ. Η αδιάλειπτη παραγωγή ηλεκτρικής ενέργειας, η ασφάλεια του προσωπικού και η διαφύλαξη του περιβάλλοντος εξαρτώνται από τη διαθεσιμότητα κρίσιμου εξοπλισμού, όπως οι λέβητες παραγωγής ατμού, οι ατμοστρόβιλοι και αεριοστρόβιλοι, οι μηχανές εσωτερικής καύσης, τα μηχανήματα εξόρυξης λιγνίτη, και οι υδροηλεκτρικές μονάδες. Τα είδη της διάβρωσης που έχουν καταγραφεί και μελετηθεί τα τελευταία είκοσι χρόνια στον εξοπλισμό αυτό είναι: Ομοιόμορφη διάβρωση (uniform corrosion) – Επιλεκτική διάβρωση (selective corrosion) – Περικρυσταλλική διάβρωση (intergranular corrosion) – Γαλβανική διάβρωση (galvanic corrosion) – Βελονοειδής διάβρωση (pitting corrosion) – Stress corrosion – Crevice corrosion – Filiform corrosion – Flow Accelerated Corrosion – Διάβρωση με κόπωση (corrosion

fatigue) – Διάβρωση με φθορά (erosion-corrosion). Αντίστοιχα τα είδη της φθοράς που έχουν παρατηρηθεί είναι: Abrasion – Adhesion – Surface fatigue – Tribochemical reaction. Η παρούσα εργασία εστιάζει σε παραδείγματα (case studies) αστοχιών και συγκεκριμένα:

- Φθορά χιτωνίων ΜΕΚ στον ΑΣΠ Χίου
- Διάβρωση με κόπωση (Corrosion Fatigue) στον ψεκασμό υπερθέρμου ατμαγωγού ΑΗΣ Λαυρίου Μονάδα
- Διάβρωση από τα προϊόντα καύσης πετρελαίου (Oil ash corrosion) στους αυλούς λέβητα ΑΗΣ Αθερινόλακκου
- Flow Accelerated Corrosion ΑΗΣ Χανίων
- Βελονοειδής διάβρωση (pitting corrosion) σε αγωγό του δικτύου πετρελαίου του ΑΗΣ Λινοπεραμάτων
- Γαλβανική διάβρωση σε σωλήνα

Οι αστοχίες μελετήθηκαν οπτικά, μεταλλουργικά, χημικά και μηχανικά προκειμένου να προσδιοριστεί ο μηχανισμός που οδήγησε σε αυτές, και να δοθούν συμβουλές στις παραγωγικές μονάδες της ΔΕΗ για τη γενεσιουργό αιτία και τους τρόπους αποφυγής τους.

Cutting-edge research in Public Power Corporation S.A.

Κωνσταντίνος Χρυσάγης, Αριστείδης Αρβανίτης, Ανέστης Αναστασιάδης, Αλέξιος Λεκίδης, Γεώργιος Παπαδάκης

Διεύθυνση Συντονισμού Ερευνητικών Προγραμμάτων - Δημόσια Επιχείρηση Ηλεκτρισμού Α.Ε.

Abstract

Η ΔΕΗ, ως ο μεγαλύτερος ενεργειακός όμιλος της χώρας, δραστηριοποιείται ενεργά στον κλάδο της έρευνας και της καινοτομίας, σε ένα ευρύ φάσμα θεματικών περιοχών. Στόχος είναι η ανάπτυξη τεχνογνωσίας σε θέματα αιχμής του ενεργειακού περιβάλλοντος, η βελτίωση και ψηφιοποίηση των λειτουργιών της σε ευθυγράμμιση με τις εξελίξεις του διεθνούς επιχειρηματικού περιβάλλοντος, η αντιμετώπιση κινδύνων για το φυσικό περιβάλλον, η αξιοποίηση των φυσικών πόρων και η υποστήριξη του ερευνητικού έργου ελληνικών, αλλά και διεθνών, οργανισμών ανάπτυξης γνώσης και πανεπιστημίων. Η δραστηριότητα αυτή αποτελεί έμπρακτη συνεισφορά της επιχείρησης στο κοινωνικό περιβάλλον, και ταυτόχρονα μακροπρόθεσμη επένδυση στις αναπτυσσόμενες τεχνολογίες, και εξέλιξη των μελλοντικών στρατηγικών της στόχων.

Η έρευνα στη ΔΕΗ ευθυγραμμίζεται με τους επιχειρηματικούς στόχους: ενέργεια, περιβάλλον και βιωσιμότητα, σχεδιασμός – κατασκευές – υλικά, ψηφιακά και βιομηχανικά συστήματα / ασφάλεια κυβερνοχώρου. Οι θεματικές περιοχές ενδιαφέροντος έχουν καθοριστεί με βάση αυτούς τους στόχους και είναι οι εξής:

- Ανανεώσιμες πηγές ενέργειας, έξυπνα δίκτυα, μικροδίκτυα
- Διαχείριση ενέργειας
- Ηλεκτροκίνηση
- Big Data, Τεχνητή Νοημοσύνη, Κυβερνοασφάλεια
- Internet of Things, Unmanned Aerial Vehicles
- Αποθήκευση ενέργειας, Επιστήμη των Υλικών

- Περιβάλλον, Κυκλική Οικονομία
- Υδρογόνο

Η ανάπτυξη, ο συντονισμός και η υποστήριξη των δραστηριοτήτων έρευνας γίνεται από τη Διεύθυνση Συντονισμού Ερευνητικών Προγραμμάτων της ΔΕΗ. Επί του παρόντος, η ΔΕΗ συμμετέχει σε περίπου 40 Ευρωπαϊκά και Εθνικά έργα, τα οποία και παρουσιάζονται επιγραμματικά. Η Διεύθυνση Κέντρου Καινοτομίας είναι ο εργαστηριακός κλάδος της επιχείρησης, και ένας από τους βασικούς τόπους διεξαγωγής πιλοτικών δοκιμών και μελετών.

Αντιτριβικός χαρακτηρισμός επικαλύψεων Ατμοσφαιρικού Ψεκασμού με φλόγα πλάσματος για χρήση σε συνθήκες έντονης μηχανικής φθοράς

Η. Γεωργιόπουλος, Δ. Γιασαφάκη, Π. Ιωάννου, Κ. Ανδρεούλη

ΕΒΕΤΑΜ Α.Ε Παράρτημα Θήβας, 76ο χλμ Ε.Ο. Αθηνών-Λαμίας, 32009 Σχηματάρι

Abstract

Η μηχανική καταπόνηση μεταλλικών εξαρτημάτων είναι συχνό φαινόμενο σε βιομηχανικές γραμμές παραγωγής. Η προστασία των εξαρτημάτων αυτών είναι δυνατή με επικαλύψεις θερμικού ψεκασμού[1,2]. Για τον λόγο αυτό γίνεται χρήση κραμάτων και σύνθετων κεραμο-μεταλλικών υλικών ως «θυσιαζόμενα» υλικά για την προστασία του υποστρώματος και την αύξηση του χρόνου ζωής του.

Στην εργασία αυτή έγινε αρχικά μελέτη και βελτιστοποίηση των συνθηκών απόθεσης επικαλύψεων με την τεχνική του Ατμοσφαιρικού Ψεκασμού με φλόγα πλάσματος με γνώμονα την ποιότητα της μικροδομής και της πρόσφυσής τους στο υπόστρωμα[3]. Για τη μελέτη αυτή χρησιμοποιήθηκε Ηλεκτρονική Μικροσκοπία Σάρωσης σε συνδυασμό με στοιχειακή ανάλυση EDS. Κράματα νικελίου-μολυβδαινίου και κοβαλτίου καθώς και σύνθετα υλικά (καρβίδια του βολφραμίου και του χρωμίου σε μεταλλική μήτρα και μολυβδένιο με κράμα νικελίου) χρησιμοποιήθηκαν ως επιστρώματα.

Στη συνέχεια χαρακτηρίστηκαν ως προς την αντιτριβική τους συμπεριφορά με δοκιμές pin-on-disc χρησιμοποιώντας ως αντίπαλο υλικό καρβίδιο του βολφραμίου (WC). Από τις δοκιμές αυτές μετρήθηκαν ο ρυθμός φθοράς και ο συντελεστής τριβής της κάθε επικάλυψης. Συνδυαστικά, μετρήσεις μικροσκληρότητας Vickers και τάσης αποκόλλησης από το υπόστρωμα (PATTI test) ολοκλήρωσαν τη μελέτη. Σύμφωνα με τις μετρήσεις σε εργαστηριακά δοκίμια, οι επικαλύψεις καρβιδίου του βολφραμίου εμφάνισαν βελτιωμένη αντιτριβική συμπεριφορά συγκριτικά με αυτή των κραμάτων νικελίου – μολυβδενίου και κοβαλτίου αλλά και του καρβιδίου του χρωμίου.

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Τεχνικές δυνατότητες και λύσεις προστασίας από φθορά με τεχνικές θερμικού ψεκασμού

Η. Γεωργιόπουλος, Δ. Γιασαφάκη, Π. Ιωάννου, Κ. Ανδρεούλη

ΕΒΕΤΑΜ Α.Ε Παράρτημα Θήβας, 76ο χλμ Ε.Ο. Αθηνών-Λαμίας, 32009 Σχηματάρι

Abstract

Η τεχνική του θερμικού ψεκασμού είναι εδραιωμένη εδώ και πολλές δεκαετίες στην παγκόσμια βιομηχανική πρακτική καθώς προσφέρει τη δυνατότητα απόθεσης, ως διεργασία ενός βήματος, επικαλύψεων πολλών και διαφορετικών υλικών (μετάλλων, κραμάτων, κεραμικών και σύνθετων) σε πάχη 20-1000 μm, σε μικρό χρονικό διάστημα και σε διαφορετικούς τύπους υποστρωμάτων[1,2]. Επιπρόσθετα, η μεγάλη ευελιξία της μεθόδου απόθεσης, ως προς την πολυπλοκότητα σχημάτων και διαστάσεων των υποστρωμάτων, σε συνδυασμό με το χαμηλό κόστος της συγκριτικά με άλλες τεχνικές απόθεσης επιστρωμάτων ενισχύουν την ευρεία χρήση της σε πλήθος εφαρμογών[3].

Η προστασία μεταλλικών εξαρτημάτων από μηχανική φθορά είναι από τις εφαρμογές στις οποίες ο θερμικός ψεκασμός δίνει αποτελεσματικές λύσεις. Μεταλλικά εξαρτήματα σε βιομηχανικές γραμμές παραγωγής υφίστανται διάφορους τύπους φθοράς όπως φθορά εκτριβής, φθορά ολίσθησης, φθορά από προσπίπτοντα σωματίδια καθώς και συνδυασμούς αυτών[4]. Προστασία των εξαρτημάτων αυτών και άρα αύξηση του χρόνου λειτουργίας τους έχει ως αποτέλεσμα την αύξηση των ενδιάμεσων διαστημάτων μεταξύ των συντηρήσεων και της διακοπής λειτουργίας των βιομηχανικών γραμμών παραγωγής. Συνεκδοχικά, οι επικαλύψεις θερμικού ψεκασμού είναι δυνατό να συμβάλλουν στην αποδοτικότερη τεχνικοοικονομικά λειτουργία αυτών των βιομηχανιών. Στη συγκεκριμένη εργασία γίνεται αναφορά σε επικαλύψεις θερμικού ψεκασμού σε πτερύγια άλεσης βιομηχανικού μύλου.

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Παραγωγή Βιώσιμων Αεροπορικών Καυσίμων (SAFs) μέσω βιολογικής επεξεργασίας αερίου σύνθεσης

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Abstract

Η Διεθνής Ένωση Αερομεταφορών (IATA) έχει θέσει ως στόχο την επίτευξη μηδενικών εκπομπών άνθρακα έως το 2050, και έχει προσδιορίσει την παραγωγή βιώσιμων αεροπορικών καυσίμων (Sustainable Aviation Fuels - SAFs) ως την πιο πολλά υποσχόμενη στρατηγική, τουλάχιστον βραχυπρόθεσμα, για τη μείωση των περιβαλλοντικών επιπτώσεων του κλάδου[1]. Τα SAFs αποτελούν πλήρη υποκατάστατα των συμβατικών αεροπορικών καυσίμων (Jet A/A-1), που παράγονται από βιώσιμους πόρους (π.χ. βιομάζα) και το μεγάλο τους πλεονέκτημα είναι η συμβατότητα με την εκτεταμένη τρέχουσα υποδομή ('drop-in'). Η πολιτική της ΕΕ για τα βιοκαύσιμα, όπως αποτυπώνεται στις τελευταίες οδηγίες (RED II, ReFuelEU Aviation), επισημαίνει την ανάγκη προώθησης καυσίμων από βιογενή υπολείμματα (προηγμένα βιοκαύσιμα)[2]. Οι τεχνολογίες που βασίζονται στην αεριοποίηση είναι ένας αποτελεσματικός τρόπος μετατροπής βιογενών υπολειμμάτων σε αέριο σύνθεσης, το οποίο με τη σειρά του μπορεί να τροφοδοτήσει πολλαπλές διεργασίες σύνθεσης καυσίμων[3]. Η κύρια πρόκληση για αυτές τις διεργασίες είναι η ανάπτυξη τεχνολογιών που θα εξασφαλίζουν ανταγωνιστικότητα των παραγόμενων βιοκαυσίμων μέσω περιορισμού του κόστους παραγωγής τους. Στη παρούσα δουλειά, παρουσιάζεται μια καινοτόμα συνδυαστική θερμοχημική-βιοχημική διεργασία παραγωγής υγρών 'drop-in' αεροπορικών βιοκαυσίμων[4]. Παρέχονται τα ισοζύγια μάζας και ενέργειας της τεχνολογίας, καθώς και τα πρώιμα τεχνοοικονομικά και περιβαλλοντικά χαρακτηριστικά της.

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Functional coatings for smooth operation and stable performance of flat-type solar panels under various conditions

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Abstract

Solar collectors, when exposed to the elements, are vulnerable to factors that lead to performance reduction such as solid pollutants, dust, and rain. Solar collectors must therefore operate under harsh conditions while achieving stable performance and high efficiency. Functional coatings for the glass surface of the collector plate have been proposed as a solution to aid in the performance stability of solar collectors. In this work, that has been completed within the framework of "Solar Kit" research project, functional coatings for flat plate solar collectors have been developed, applied using cold spraying method and have been tested. The coating sprays do not contain Volatile Organic Compounds (VOCs) because they are sprayed using water-based emulsions thus reducing the required active substance concentration and the environmental impact of using VOCs. The effectiveness of the coatings has been validated by contact angle (CA) measurements. Since the coated surfaces concern solar absorber plates, low reflectiveness and high transmittance factors are the key evaluation parameters for achieving maximum solar radiation absorption and avoid performance degradation of the solar collector. Measurements for the total reflectiveness and total transmittance of the coatings have been performed showing that total reflection of the coated glass is lower that the untreated for up to 6 coating layers while the transmission of the coated glass is improved for up to 3 coating layers. This leads to the conclusion that up to three coating layers can be applied to the collector's glass without affecting its performance while simultaneously improving its anti-pollution and self-cleaning attributes.

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Development of redox stable, bi-functional cathodes for reversible solid oxide cells

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Abstract

The use of fossil fuels is widely considered as the primary cause of global warming due to the resulting greenhouse gas emissions. This has led to a pressing need to transition towards more sustainable and environmentally friendly alternative fuels. Solid oxide electrolytic cells (SOECs) offer an efficient way to recover CO_2 emissions from heavy industry and transportation that have been released into the atmosphere. SOECs are known for their high efficiency compared to other alternatives. Our aim is to develop A-site deficient perovskite materials of exceptional redox stability and tailored ionic-electronic conducting properties for efficient syngas production in reversible solid oxide electrolysis/fuel cells, utilizing the reaction $CO_2 + H_2O \rightleftarrows CO + H_2 + O_2$. Several candidate cathode materials have been prepared, utilizing the LSCM (La, Sr, Cr, X) formulation of perovskite oxide material, with the general formula La0.75Sr0.25Cr0.5X0.5O3-δ (X=Mn, Fe). Several B-site doping strategies in A-site deficient perovskites have also been employed, with the ultimate goal of studying the formation of mono- or multi-metallic nanoparticles obtained after exsolution.

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Πιλοτική εφαρμογή καινοτόμων επικαλύψεων και πλάνο βιομηχανοποίησης της παραγωγής

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Abstract

Στην εργασία αυτή παρουσιάζεται η πιλοτική εφαρμογή των καινοτόμων επικαλύψεων και πιθανά αποτελέσματα που αφορούν τη χρήση τους καθώς και το πλάνο αξιοποίησης και βιομηχανοποίησης της παραγωγής τους. Πιο συγκεκριμένα θα αναλυθεί η διαδικασία άλεσης στερεού καυσίμου σε πιλοτικό μύλο άλεσης και η λειτουργία μιας φυγόκεντρης αντλίας με τη χρήση γαλακτώματος αποθείωσης. Παράλληλα θα παρουσιαστούν αναλύσεις τόσο του καυσίμου όσο και του γαλακτώματος με στόχο τον προσδιορισμό της σύστασης και των βασικών τους φυσικοχημικών χαρακτηριστικών. Ταυτόχρονα η εργασία θα εστιάσει στις λειτουργικές παραμέτρους και τα σημεία μέγιστης φθοράς των βιομηχανικών μύλων άλεσης και των αντίστοιχων φυγόκεντρων αντλιών, όπως αυτά προσδιορίστηκαν μέσω βιβλιογραφικής ανασκόπησης. Στη συνέχεια θα παρουσιαστεί ένα πλάνο διείσδυσης των επικαλύψεων στην αγορά και βιομηχανοποίησης της παραγωγής τους αναλύοντας τους πιθανούς πελάτες, το μέγεθος της αγοράς και τον ανταγωνισμό, θα αναφερθούν κρίσιμες χρηματοοικονομικές παράμετροι, όπως το κόστος επένδυσης, το κόστος λειτουργίας και οι προβλεπόμενες πωλήσεις, ενώ θα περιγράφουν οι ενδεικτικές τιμές των προβλεπόμενων εσόδων και εξόδων για τη βιομηχανοποίηση της παραγωγής. Τέλος θα αναφερθούν συνοπτικά κάποιες δυσχέρειες που παρουσιάστηκαν κατά τη διάρκεια της πιλοτικής εφαρμογής.

Study of magnetic particles in soils from Central Macedonia, N. Greece

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Abstract

Natural processes or human activities can have hazardous effects in soils causing contamination in some heavy metals. The present study has been carried out to determine

the morphological and chemical characteristics of the magnetic particles extracted from soil samples from Central Macedonia, N. Greece.

41 soil samples were collected from different areas of Northern Greece. All samples were dried and sieved (<150μm) and analyzed for 9 major elements with X-ray fluorescence (XRF). Studies have shown a connection between the heavy metal content of soils and its magnetic particles (Hu et al. 2007, Jordanova et al. 2003) so the magnetic particles from a subsample of 22 samples with values Fe_2O_3>8% were extracted from the soils using a hand magnet and examined with scanning electron microscopy (SEM) coupled with an energy dispersive spectrometer (EDS) to determine their morphological and chemical characteristics. This subsample was also analyzed with inductively coupled plasma mass spectrometry (ICP-MS) for 10 trace elements that were extracted by the aqua regia method according to ISO 11466.

SEM-EDS revealed the presence of crystal shaped magnetic Fe-rich particles of minerals such as magnetite and chromite. The chemical analyses of the samples determined high values of Cr, Ni, As and Pb in some spots of the study area.

The geological formations of the study area vary including ultramafic rocks, sedimentary rocks as well as metamorphic rocks (Mountrakis, 2020). The chemical composition of the soil samples was mapped and compared to the geology of the study area. High values of Cr and Ni are associated to ultramafic rocks and high values of As are associated to hydrothermal activity pointing to geogenic origin. High values of Pb are probably associated to human activities in the area pointing to anthropogenic origin.

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Development and evaluation of thermal sprayed corrosion protective coatings over engineering alloys

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Abstract

In harsh and corrosive industrial environments, steel parts and equipment can degrade rapidly, leading to reduced performance, shorter lifespan, and increased repair or replacement costs [1]. To address this issue, functional coatings can be applied to provide protection against corrosion and fatigue [2-6], resulting in prolonged lifespan, reduced material waste, and improved resource economy. In this study, the effectiveness of three types of functional coatings applied via thermal spraying to carbon steel was evaluated. The first coating was a nickel-based commercial corrosion-resistant metallic alloy powder called Diamalloy, the second was WOKA powder, and the third was Alumina powder. The coated specimens were sealed to reduce porosity and further functionalized through gas phase deposition of trichloro(1H,1H,2H,2H-perfluorooctyl) silane as described previously [7]. Electrochemical measurements, and contact angle studies were then conducted to assess the coatings' effectiveness under harsh corrosive conditions with sulfates present.

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Durable bi-functional coating on stainless steel 304

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Abstract

Industries can benefit from utilizing low-temperature waste heat as an energy source, but its recovery is challenging due to the need for specific materials that can withstand below dew point temperatures and corrosive flue gases [1,2]. To address these obstacles, durable bi-functional coatings are crucial, because the coatings that exhibit characteristics like super-hydrophobicity [3], dropwise condensation (DwC) [4], and corrosion protection [5], can notably improve the efficiency waste heat recovery systems. Specifically, avoiding filmwise condensation (FwC) and augmenting dropwise condensation (DwC), can lead to improvements in the rate of water condensation and heat transfer [6]. This research focuses on the development and evaluation of such bi-functional coatings that exhibit superior durability, superhydrophobicity, and corrosion protection for 304 stainless steel. These coatings exhibit limited interaction with corrosive aqueous media, demonstrated by a high contact angle (157.8^{o}) and low roll-off angle (2.6^{o}). Additionally, the coated specimens can efficiently condense humidity in a dropwise manner and withstand continuous condensation for 120 hours. The coatings also display thermal shock and wear resistance while providing 91.4% corrosion protection efficiency.

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This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call “Special Actions AQUACULTURE – INDUSTRIAL MATERIALS – OPEN INNOVATION IN CULTURE” (project code: T6YBP-00350).

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Circular Economy: From concept to implementation, agri-food oriented

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Abstract

The consumption of natural resources and waste production raises questions and concerns for the global scientific community and government decision-makers. This work provides information related to the concept of the circular economy and how the transition from a linear to a more circular system would prove to be a particularly sustainable practice in resource and waste management, ensuring the sustainable use and minimized consumption of resources, but also reduced production, the reuse and the controlled disposal of waste as nutrients of a subsequent system. European Union supports the actions and provides the Action Plan, regarding the sustainable policy, as well as the expected goals from this activity. The work provides information regarding the principles of the circular economy in the agri-food sector as well as the the necessity of its application to address the existing challenges that the specific sector must face and the benefits that can arise from such a transition.

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Towards Nanofluids with excellent light radiation absorption

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Abstract

In this work, we report results on an innovative Carbon-based nanofluid suitable for increased light radiation absorption [1,2]. The innovation resides on the interaction mechanisms of light photons with the nanoparticles, focusing on photon trapping inside the nanoparticles, thus taking advantage of their consecutive inelastic scattering [3] with their inner walls, until they deliver most of their energy. Sizes and shapes of the nanoparticles are of major importance. A quick estimation considering photons' wavelengths to be captured, e.g. for visible spectrum lengths around 560 nm or near IR, the nanoparticles' cavities must have diameters around 600nm or more. Consequently, combinations of different sized nanoparticles are considered, in addition to their sizes and shapes. A second important parameter is the phonons creation (few μm), related with the nano-particles' lengths. Also, these phonons must be able to propagate. We adopted a low thermal conductivity liquid and a "thermal conduction path" related with a percolation threshold that correlates with the optimum concentration of the nanoparticles. The intrinsic nanoparticles' thermal conductivity of the material is also important. Preliminary experiments provided very promising results.

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Greenhouse heating and cooling performance assessment using a novel CO_2 ground-source heat-pump

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Abstract

Recent EU legislation and proposals concerning the gradual phase-out of refrigerant substances with either high GWP or negative impact on human health (F-gas regulation, PFAS ban), lead to the promotion of carbon dioxide (R744) as the most viable and long-term refrigerant alternative for the refrigeration and air-condition systems. In the meantime, the integration of RES in the refrigeration configurations seems necessary for the climate neutrality EU goal by 2050 (Green Deal). The current study presents a theoretical energy analysis of a novel ground-source heat pump with R744 refrigerant for covering the heating and cooling needs of a greenhouse plant in the Psachna region. The proposed arrangement uses a vapor ejector for the reduction of the working compression ratio, plus it integrates a swallow geothermal heat exchanger for heat rejection and absorption during the summer and winter periods respectively. The energetic assessment uses validated numerical models developed in MATLAB using CoolProp library. Results show efficiency rates increment up to 16% for the heating mode and up to 13% for the cooling mode respectively for the proposed topology compared to a conventional air-cooled system. The average annual improvement of COP is 7%, which leads to electricity savings of 59.48 MWh/year in comparison to the conventional case.

Implementation of green special processes in aerospace industry

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Abstract

Special processes in aircraft and aircraft engines Maintenance Repair and Overhaul (MRO) are processes that require specific and advanced skills, equipment, and detailed procedures to ensure the quality and safety of the maintenance work. Such special processes include, but not limited to, Welding, Surface Engineering & Chemical Processing, Electronics

manufacturing, Composites, Elastomer Seals, Heat Treatment, Thermal Spraying, Materials Testing & Inspection, Nonconventional Machining, Non-destructive Testing etc.

In order to minimize the environmental impact of aircraft MRO and therefore the environmental impact of the aircraft in total, green special processes should be developed and implemented [1-5]. To this end, aerospace industries should focus not only on the development of the special processes, but also on the development of the respective Training Curricula through which employees will be trained on these chemical processes. These Curricula ought to be suitable for continuing Vocational Educational Training (cVET) and comply to the pertaining peculiarities, since they will be offered not only to new, but also to experienced personnel.

We present this route, after the phase of technology maturation. Revisiting the respective Occupational Profiles and developing Curricula in order to train personnel to be competent for these technologies. We also outline an example for the drag-out in chemical processes [1].

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Παραγωγή «πράσινου» υδρογόνου από το νερό κατά την ακτινοβόληση τροποποιημένων νανοσωματιδίων τιτανίας με ηλιακό φως

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Abstract

Με την ενεργειακή κρίση να μην αποτελεί πλέον μελλοντικό σενάριο αλλά να επηρεάζει την καθημερινότητα όλων, η αξιοποίηση εναλλακτικών καυσίμων κρίνεται αναγκαία. Το υδρογόνο αποτελεί μια ιδανική επιλογή καυσίμου καθώς έχει μεγάλο ενεργειακό

περιεχόμενο, ενώ η καύση του παράγει μηδενικό περιβαλλοντικό αποτύπωμα[1]. Ένας από τους πλέον υποσχόμενους τρόπους παραγωγής υδρογόνου είναι η φωτοκαταλυτική διάσπαση του νερού με χρήση νανοδομημένων ημιαγωγών και την ακτινοβόλησή τους με ηλιακό φως[2]. Το διοξείδιο του τιτανίου (TiO_2) αποτελεί έναν ευρέως μελετημένο φωτοκαταλύτη που χαρακτηρίζεται από χαμηλή τοξικότητα και μεγάλη χημική σταθερότητα, με την δράση του όμως να περιορίζεται από τον γρήγορο ανασυνδυασμό των φωτοπαραγόμενων φορτίων και την απορρόφηση στο εγγύς υπεριώδες[3].

Στην παρούσα μελέτη αναπτύχθηκε μια χαμηλού κόστους συνθετική πορεία για την παραγωγή νανοσωματιδίων τιτανίας (TiO_2) τροποποιημένων με χαλκό (Cu). Ο χαρακτηρισμός τους έγινε με συνδυασμό τεχνικών, όπως περιθλασιμετρία ακτίνων Χ (XRD), φασματοσκοπία UV-Vis, PL, IR-ATR και Raman καθώς και ηλεκτρονική μικροσκοπία σάρωσης (SEM). Η δυνατότητα απορρόφησης τους στο φάσμα του ορατού αξιολογήθηκε μέσω της αποικοδόμησης της χρωστικής Μπλε του Μεθυλενίου κατά την ακτινοβόλησή τους με λάμπες LED. Η δραστικότητα τους στην φωτοκαταλυτική διάσπαση του νερού για την παραγωγή υδρογόνου μελετήθηκε σε διαφορετικά εύρη μηκών κύματος της ηλιακής ακτινοβολίας, ενώ προσδιορίστηκε η συγκέντρωση του χαλκού που οδήγησε το καταλυτικό σύστημα στη μέγιστη δραστικότητα.

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Bioenergy production from tannery waste via a single-chamber Microbial Fuel Cell with steel anodes and Escherichia coli (E. coli)

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Abstract

Microbial Fuel Cells (MFCs) are gaining popularity as cutting-edge biochemical reactors that consume waste substrates in order for the electrogenic bacteria and/or enzyme cultures to produce electricity and, simultaneously, to lower environmentally hazardous values of wastes. Many different anodic and cathodic electrodes with many variants have been employed in MFC designs, with ceramic and metal-based electrodes gaining favor over state-of-the-art electrodes [1-4]. In this research, a single chamber microbial fuel cell was operated with commercial steel sponges as anode electrodes, and ceramic electrodes as a cathode, whilst the use of Escherichia coli (E. coli) bacteria was evaluated as the bacteria for treating tannery waste. Stainless steel electrodes outperformed carbon felt in terms of power generation and COD tannery treatment. A COD decrease of almost 80% was achieved with stainless steel followed by an increased power output of 50% in comparison with carbon-felt electrodes.

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Structural and catalytic properties of manganese-based mixed oxides

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Abstract

Metal oxides exhibit a wide variety of physicochemical characteristics, closely related to their composition enabling them as versatile materials in heterogeneous catalysis [1-6]. Their

interaction with other oxides as mixed systems or support can further modulate their properties. In the case of manganese oxides, they are known as efficient catalysts due to the different available oxidation states of manganese and their catalytic properties can be further modified or improved when manganese oxides are prepared as mixed systems with other metal oxides or when special structural features are introduced. In this work manganese-based mixed oxides are discussed for their properties and their structure and composition effect on their catalytic performance in typical redox reactions. Such structural features are introduced by the synthesis method applied and both composition and structural characteristics can be used to control the catalytic performance. By synthesizing rare earth, transition metals and or alkaline earth can be introduced towards mixed systems and perovskite structure formation [7-11].

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Preparation of super-hydrophobic surface: Study on the Effects of Sandblasting stainless steel

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Abstract

Due to the vast range of applications, there has been a lot of study into creating surfaces with hydrophobic and self-cleaning properties. Such surfaces lessen the need for cleaning and maintenance by promoting the dropwise condensation effect. Controlling the surface shape and energy is essential for producing super-hydrophobicity. Surface energy relates to the chemical interactions between the surface and the surroundings, whereas surface morphology refers to surface roughness and microstructure. The main goal of this work was to develop super-hydrophobic surface morphology on sandblasted stainless steel 304 samples. At first, the effect of the sandblasting procedure was estimated by using four different Al2O3 as blasting medium with a range of particle size from 53-425 μm. Smaller particle sizes of the blasting media led to increased roll-off angles. Furthermore, the sandblasted specimens were coated by CVD with trichloro(1H,1H,2H,2H-perfluorooctyl) silane, leading to super-hydrophobicity in all specimens. Finally, water condensation experiments showed that low-range particle size blasting media with CVD coatings enhanced dropwise condensation. The findings of this study may open the door to creating extremely effective self-cleaning surfaces in various industries [1-5]

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