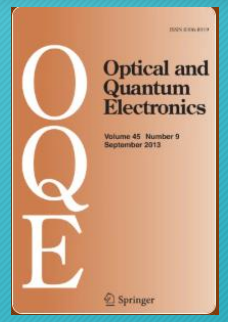
K. Ozel, A. Atilgan, N. Akdogan, E. B. Yurdakul, G Dilek, ***A. Yildiz***, A. Disli, Y. Erdogdu

An assessment of the photovoltaic characteristics of some azo dyes for dye-sensitized solar cells: insights from experimental and theoretical studies



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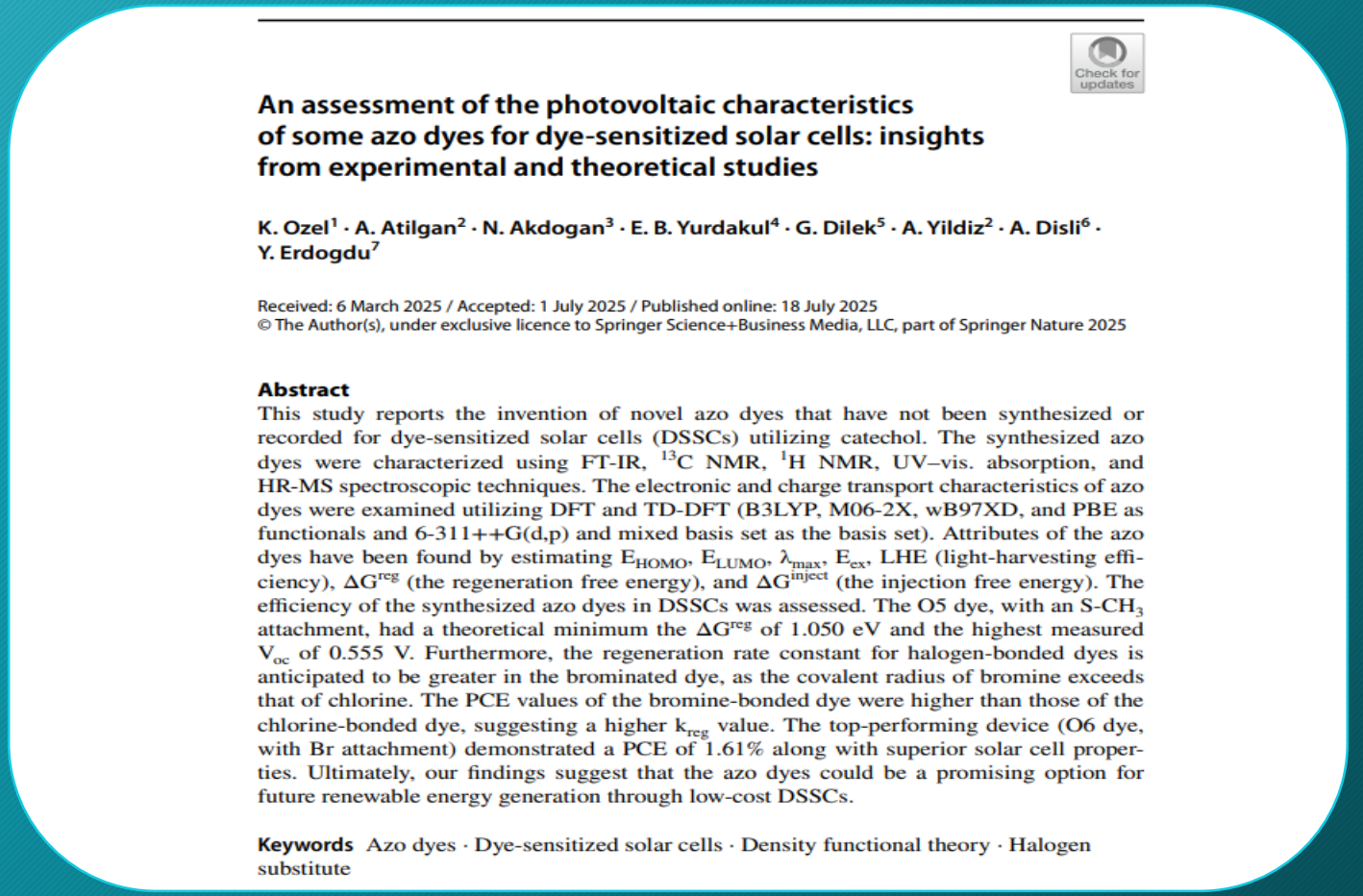

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An assessment of the photovoltaic characteristics of some azo dyes for dye-sensitized solar cells: insights from experimental and theoretical studies

K. Ozel[1] · A. Atilgan[2] · N. Akdogan[3] · E. B. Yurdakul[4] · G. Dilek[5] · A. Yildiz[2] · A. Disli[6] · Y. Erdogdu[7]

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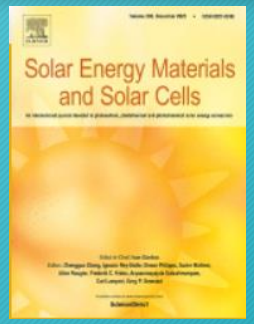
Abstract
This study reports the invention of novel azo dyes that have not been synthesized or recorded for dye-sensitized solar cells (DSSCs) utilizing catechol. The synthesized azo dyes were characterized using FT-IR, ^{13}C NMR, ^{1}H NMR, UV–vis. absorption, and HR-MS spectroscopic techniques. The electronic and charge transport characteristics of azo dyes were examined utilizing DFT and TD-DFT (B3LYP, M06-2X, wB97XD, and PBE as functionals and 6-311++G(d,p) and mixed basis set as the basis set). Attributes of the azo dyes have been found by estimating E_{HOMO}, E_{LUMO}, λ_{max}, E_{ex}, LHE (light-harvesting efficiency), ΔG^{reg} (the regeneration free energy), and ΔG^{inject} (the injection free energy). The efficiency of the synthesized azo dyes in DSSCs was assessed. The O5 dye, with an S-CH_3 attachment, had a theoretical minimum the ΔG^{reg} of 1.050 eV and the highest measured V_{oc} of 0.555 V. Furthermore, the regeneration rate constant for halogen-bonded dyes is anticipated to be greater in the brominated dye, as the covalent radius of bromine exceeds that of chlorine. The PCE values of the bromine-bonded dye were higher than those of the chlorine-bonded dye, suggesting a higher k_{reg} value. The top-performing device (O6 dye, with Br attachment) demonstrated a PCE of 1.61% along with superior solar cell properties. Ultimately, our findings suggest that the azo dyes could be a promising option for future renewable energy generation through low-cost DSSCs.

Keywords Azo dyes · Dye-sensitized solar cells · Density functional theory · Halogen substitute

Abid Ustaoglu, Saman Menbari, Osman Gencel, Ercan Aydogmus, Ahmet Sarı, ***Bülent Yesilata***, Togay Ozbakkaloglu, Orhan Uzun

Development and characterization of coconut oil-based phase change material integrated flexible polyurethane biocomposites for thermal energy storage applications



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Prof. Dr. Bülent Yeşilata, Energy Systems Engineering

Development and characterization of coconut oil-based phase change material integrated flexible polyurethane biocomposites for thermal energy storage applications

Abid Ustaoğlu [a,*], Saman Menbari [b], Osman Gencel [c,**], Ercan Aydoğmuş [d], Ahmet Sarı [e,f], Bülent Yeşilata [g], Togay Ozbakkaloglu [b], Orhan Uzun [h]

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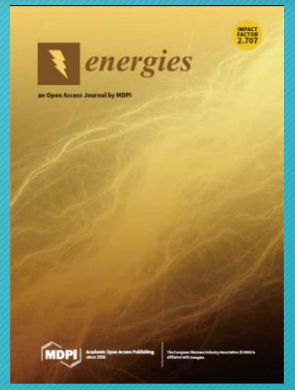
ABSTRACT

With growing global energy demand and the urgent need to reduce carbon emissions, developing sustainable materials with thermal energy storage capabilities has become essential. This study introduces, for the first time, a flexible polyurethane biocomposite (FPB) containing directly integrated unencapsulated coconut oil-based phase change material (CO-PCM), without micro-shells or encapsulation. This novel approach simplifies fabrication, reduces cost, and enhances thermal and mechanical performance through direct polymer–phase change material interaction. Flexible polyurethane biocomposites incorporating varying concentrations (0 %, 15 %, 30 %, and 45 %) of CO-PCM were synthesized using a two-step method involving polyether polyol, isocyanate, and a catalyst. Increasing CO-PCM content improved the physical and thermal properties of the composites. At 45 wt% CO-PCM, bulk-density increased by 51 %, Shore A hardness by over 43 %, and tensile strength by 14 %, while strain decreased from 82 % to 53 %. Thermal conductivity improved by 15 %, and activation energy rose by 30 %, indicating enhanced thermal stability. The composites were characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and scanning electron microscopy (SEM). Thermoregulation tests showed that the FPB with 45 % CO-PCM reduced peak surface temperatures by up to 6.8 °C during the day and retained 2.4 °C more heat at night, contributing to stable indoor thermal conditions. Energy simulations across four climate zones revealed that FPB-45 could reduce heating energy demand by up to 26 % compared to conventional expanded polystyrene (EPS) insulation. CO_2 emission analysis indicated up to 10 kg/m^2 annual reduction, and up to \$1.80/m^2 annual savings when using fuel oil, proving its technical and economic viability.

Obed N. Onsomu, Erman Terciyanlı, ***Bülent Yesilata***

Optimal Dispatch of a Virtual Power Plant Considering Distributed Energy Resources Under Uncertainty



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Energy Systems Engineering

Article

Optimal Dispatch of a Virtual Power Plant Considering Distributed Energy Resources Under Uncertainty

Obed N. Onsomu [1,2,*], Erman Terciyanlı [2] and Bülent Yeşilata [1]

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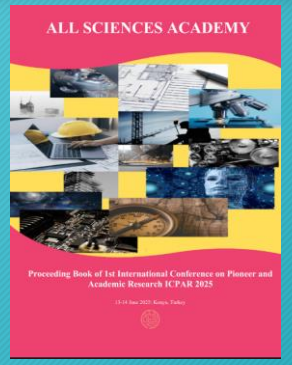
Abstract

The varying characteristics of grid-connected energy resources necessitate a clear and effective approach for managing and scheduling generation units. Without proper control, high levels of renewable integration can pose challenges to optimal dispatch, especially as more generation sources, like wind and solar PV, are introduced. As a result, conventional power sources require an advanced management system, for instance, a virtual power plant (VPP), capable of accurately monitoring power supply and demand. This study thoroughly explores the dispatch of battery energy storage systems (BESSs) and diesel generators (DGs) through a distributionally robust joint chance-constrained optimization (DR-JCCO) framework utilizing the conditional value at risk (CVaR) and heuristic-X (H-X) algorithm, structured as a bilevel optimization problem. Furthermore, Binomial expansion (BE) is employed to linearize the model, enabling the assessment of BESS dispatch through a mathematical program with equilibrium constraints (MPECs). The findings confirm the effectiveness of the DRO-CVaR and H-X methods in dispatching grid network resources and BE under the MPEC framework.

Keywords: optimal dispatch; battery energy storage system; virtual power plant; diesel generator; management

Mohammed Ismael ISMAEL, ***ÖMER ÖNDER ERAT, BÜLENT YEŞİLATA***

Economic and Energy Use Intensity Evaluation of Renewable Heating and Cooling Systems for A Sample Residential Building in Kirkuk



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Economic and Energy Use Intensity Evaluation of Renewable Heating and Cooling Systems for A Sample Residential Building in Kirkuk

Mohammed Waleed Ismael Ismael[1*], Ömer Önder ERAT [2] and Bülent Yeşilata [3]

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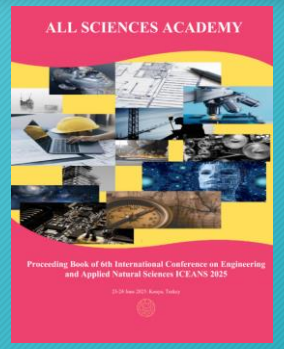
** Email of the corresponding author: Mohammed1998ismael@gmail.com*

Abstract – Energy consumption and CO_2 emissions in the world are increasing day by day. One of the biggest reasons for this increase is traditional buildings. A large portion of the electricity needed by buildings is produced from fossil resources, and as a result, CO_2 emissions increase. The concept of a nearly zero-emission building has emerged to meet this need. In the analyses conducted for a sample building in Kirkuk, Iraq, where different strategies, primarily the integration of renewable energy systems into buildings, are applied, it has been determined that the sample building's annual energy consumption intensity is reduced by approximately 65% with different strategies, while providing approximately 68% annual economic savings.

Keywords – Carbon-free energy, environmental impact, nearly zero emission buildings, sustainable energy, economic impact

Abdulaziz MURTOZAEV, *ÖMER ÖNDER ERAT, BÜLENT YEŞİLATA*

Green Hydrogen in Uzbekistan: A Techno-Economic Exploration



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Green Hydrogen in Uzbekistan: A Techno-Economic Exploration

Abdulaziz Murtozaev [1*], Ömer Önder Erat [2], Bülent Yeşilata [3]

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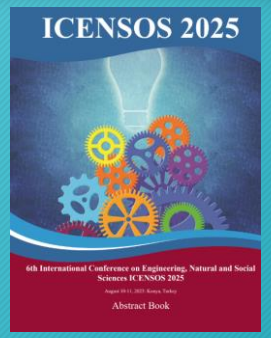
Abstract – As world population grows rapidly demand for energy is also increasing tremendously duly. To meet net zero emission targets and reducing use of fossil fuels global action has started early in 21st century. For this reason, huge focus is given on the development of renewable energy in the whole world. So renewable energy has been growing rapidly for the past 25 years especially solar, wind, hydropower, geothermal, and biomass energy. But there are some disadvantages of these sources like cost, depending on time and the weather conditions. These disadvantages make us to use new type of energy which is cost effective, available despite weather, season and contingent conditions. Green hydrogen is considered to be the future of the energy, as it offers an environmentally friendly and safe form of energy. For this study Karakalpakstan region of Uzbekistan is chosen to produce green hydrogen using Proton exchange membrane (PEM) electrolyzer powered from 100 MW wind plant in the chosen area. The Open Plan Tool is used to simulate a model and calculate techno-economic analysis. As a result of the study, it was determined that the technical feasibility and economic parameter LCOH of 6093.6 metric tons kg green hydrogen was 6.5 USD/kg under a 5% discount rate and a 20-year project life with the model applied for the examined region.

Keywords – Green hydrogen, renewable energy, wind energy, CAPEX, OPEX, LCOH.

Akın İLHAN

Numerical Thermal Analysis Performed for the Designed Bottle Using Different Materials



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Energy Systems Engineering

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ICENSOS
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Numerical Thermal Analysis Performed for the Designed Bottle Using Different Materials

Akin Ilhan*

[1]*Energy Systems Engineering Department, Ankara Yildirim Beyazit University, Türkiye*

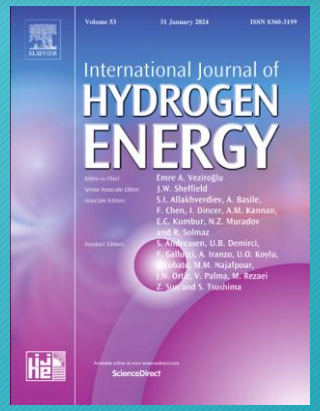
**(akinilhan@aybu.edu.tr)*

Abstract – In this study, the thermal analysis of a specially designed bottle, for commercial applications, has been performed. In this regards, initially, the temperature distribution (T_i) along the wall material of the bottle has been numerically determined; whereas, secondly, the heat flux ($\dot{q}$) distribution along the surfaces of the bottle was executed and shown. On the other hand, the wall materials of the bottle were altered. Accordingly, four different wall materials were used for this purpose. Among those, polyester, glass, stainless steel, and waterproof cork having thermal conductivity (λ) values corresponding to 0.15 W/(m.K), 1.05 W/(m.K), 15.1 W/(m.K), as well as 0.039 W/(m.K), respectively were considered. The outside ambient temperature value was taken into account to be kept to be constant at the value of 22 °C. Besides, the water that was in the liquid phase found inside the designed bottle was considered to be remained at 80 °C. And, under these environmental conditions, the temperature distributions (T_i) and the average total heat fluxes ($\dot{q}$) of these four materials were demonstrated and reported. Ultimately, in terms of the numerical outputs of the thermal analyses, the best material that preserves the liquid inside the bottle was revealed and reported to be the waterproof cork.

Keywords – Heat flux, numerical heat analysis, temperature distribution, thermal analysis

Ali Abdulwahhab Mohammed, Ali H Abdulwahhab, Alaa Hussein Abdulaal, ***Musaria Karim Mahmood***, Indrit Myderrizi, Riyam Ali Yassin, Taha Talib Abdulridha, Morteza Valizadeh

BCI-DRONE CONTROL BASED ON THE CONCENTRATION LEVEL AND EYE BLINK SIGNALS USING A NEUROSKY HEADSET



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ABSTRACT

Brain neurons activate Human movements by producing electrical bio-signals. Neuron activity is used in several technologies by operating their applications based on mind waves. The Brain-Computer Interface (BCI) technology enables a processor to connect with the brain using a signal received from the brain. This study proposes a drone controlled using EEG signals acquired by a Neurosky device based on the BCI system. Two active signals are adapted for controlling the drone motions: concentration brain signals portrayed by attention level and the

eye blinks as an integer value. A dynamic classification method is implemented via a Linear Regression algorithm for attention-level code. The eye blinking generates a binary code to control the drone's motions. The accuracy of this code is improved through Artificial Neural Networks and Machine Learning techniques. These codes (attention level and eye blink codes) drive two controlling layers and manipulate nine possible drone movements. The experiment was evaluated with several users and showed high performance for the classification methods and developed algorithm. The experiment shows a 90.37% accuracy control that outperforms most existing experiments. Also, the experiment can support 16 commands, making the algorithm appropriate for various applications.

KEYWORDS

Electroencephalogram; BCI system; Neurosky; Attention level; Eye blink.