LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH: JURNAL ILMIAH
Bukti artikel: C-7

Judul Karya Ilmiah (Artikel)	:	Synthesis and characterization of sulfonated poly(eugenol-co-allyleugenol) membranes for proton exchange membrane fuel cells
Jumlah Penulis	:	5 Orang Penulis anggota
Nama Penulis	:	Ngadiwiyana, Gunawan, **Nor Basid Adiwibawa Prasetya**, Tutuk D. Kusworo, Heru Susanto
Identitas Jurnal Ilmiah		
a. Nama Jurnal	:	Heliyon
b. Nomor ISSN	:	2405-8440
c. Volume, No, Bulan, Tahun	:	Vol. 8, issue 12, hal e12401. Tahun 2022
d. Penerbit	:	Elsevier
e. DOI artikel (jika ada)	:	https://doi.org/10.1016/j.heliyon.2022.e12401
f. URL Jurnal	:	https://www.sciencedirect.com/science/article/pii/S2405844022036891
g. Alamat web jurnal	:	https://www.sciencedirect.com/journal/heliyon
h. Indexing	:	**Scopus (Elsevier)**, Web of Science (Clarivate Analytics), Scimago Journal Rank

Kategori Publikasi Jurnal Ilmiah (beri Ppada kategori yang tepat) :

- [v] Jurnal Ilmiah Internasional Bereputasi (Q1, SJR = 0,55, IF=3,776)
- [ ] Jurnal Ilmiah Internasional
- [ ] Jurnal Ilmiah Nasional Terakreditasi
- [ ] Jurnal Ilmiah Nasional Terindeks DOAJ
- [ ] Jurnal Ilmiah Nasional Tidak terakreditasi

Hasil Penilaian *Peer Review* :

Komponen yang Dinilai	Nilai Maksimal Jurnal Ilmiah Jurnal Ilmiah Internasional Bereputasi (40)	Nilai Akhir Yang Diperoleh
a. Kelengkapan unsur isi jurnal (10%)	4	4
b. Ruang lingkup dan kedalaman pembahasan (30%)	12	11.3
c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	12	11.7
d. Kelengkapan unsur dan kualitas penerbit (30%)	12	11.75
Total = (100%)	40	39.35

Semarang, 24 Mei 2023

Reviewer 1

Prof. Dr. M. Cholid Djunaidi, S.Si, M.Si
NIP. 197007021996031004
Unit kerja:
Departemen Kimia FSM Undip
Jabatan Fungsional: Guru Besar
Bidang Ilmu: Kimia

Reviewer 2

Ismiyarto, S.Si., M.Si., Ph.D.
NIP. 196910111997021001
Unit kerja:
Departemen Kimia FSM Undip
Jabatan Fungsional: Lektor Kepala
Bidang Ilmu: Kimia

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- [ ] Jurnal Ilmiah Nasional Terindeks DOAJ
- [ ] Jurnal Ilmiah Nasional Tidak terakreditasi

Hasil Penilaian *Peer Review* :

Komponen yang Dinilai	Nilai Reviewer		Nilai Rata-rata
	Reviewer I	Reviewer II	
a. Kelengkapan unsur isi jurnal (10%)	4	4	4
b. Ruang lingkup dan kedalaman pembahasan (30%)	11,9	11,9	11,9
c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	11.8	11,6	11,7
d. Kelengkapan unsur dan kualitas penerbit (30%)	11,8	11,7	11,75
Total = (100%)	39,5	39,2	39,35

Semarang, 24 Mei 2023

Reviewer 1

Prof. Dr. M. Cholid Djunaidi, S.Si, M.Si
NIP. 197007021996031004
Unit kerja:
Departemen Kimia FSM Undip
Jabatan Fungsional: Guru Besar
Bidang Ilmu: Kimia

Reviewer 2

Ismiyarto, S.Si., M.Si., Ph.D.
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Unit kerja:
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Kategori Publikasi Jurnal Ilmiah (beri Ppada kategori yang tepat) :

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Hasil Penilaian *Peer Review*:

Komponen yang Dinilai	Nilai Maksimal Jurnal Ilmiah					Nilai Akhir Yang Diperoleh
	Internasional Bereputasi (40)	Internasional (30)	Nasional Terakreditasi (25)	Nasional Terindeks DOAJ dll. (20)	Nasional Tidak Terakreditasi (10)	
a. Kelengkapan unsur isi jurnal (10%)	4					4
b. Ruang lingkup dan kedalaman pembahasan (30%)	12					11,9
c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	12					11,8
d. Kelengkapan unsur dan kualitas penerbit (30%)	12					11.8
Total = (100%)	**40**					39,5
Kontribusi Pengusul (Penulis anggota)	40% × 39,5 : 4 = 3,95					

Komentar Peer Review:

a. **Kelengkapan dan kesesuaian unsur:** Artikel ini disusun berdasarkan guideline yang ada. Objektif dari paper ini dijabarkan dengan baik dalam komponen-komponen dalam paper ini. Terdapat hubungan atau alur yang baik pula dari satu bagian ke bagian lainnya.

b. **Ruang lingkup dan kedalaman pembahasan:** Poly(eugenol-co-allyleugenol) disintesis dengan monomer eugenol dan allyleugenol dengan menggunakan katalis BF3. Selanjutnya kopolimer dimodifikasi dengan penambahan gugus sulfonat melalui reaksi dengan asam sulfat sebagai agen sulfonasi. Optimasi diteliti melalui variasi waktu kontak dalam reaksi sulfonasi.

c. **Kecukupan dan kemutahiran data/informasi dan metodologi:** Data yang disajikan dalam paper ini meliputi data karakterisasi material polimer menggunakan FTIR, H-NMR, swelling degree, analisis termal TGA-DSC. Novelty yang dihasilkan adalah modifikasi dengan gugus sulfonat menaikkan kestabilan termal dari material. Secara keseluruhan, metodologi didesain dengan langkah yang baik dan mutakhir dan didukung dengan referensi yang mayoritas berusia tidak lebih dari 10 tahun.

d. **Kelengkapan unsur dan kualitas penerbit:** Jurnal Heliyon termasuk dalam kategori jurnal Q1 dengan nilai SJR 0,61. Similarity indeks dari paper ini sebesar 15% yang kemunikan berasal dari kalimat yang memiliki susunan yang mirip, akan tetapi secara substansi tidak terindikasikan adanya plagiasi dalam paper ini. Kualitas paper ini juga dapat dilihat dari jumlah referensi yang banyak yang digunakan.
Turnitin: similarity 15%

Semarang, 15 Mei 2023
Reviewer 1

Prof. Dr. M. Cholid Djunaidi, S.Si, M.Si
NIP. 197007021996031004

Unit kerja :
Departemen Kimia FSM Undip
Jabatan Fungsional: Guru Besar

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Hasil Penilaian *Peer Review*:

Komponen yang Dinilai	Nilai Maksimal Jurnal Ilmiah					Nilai Akhir Yang Diperoleh
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a. Kelengkapan unsur isi jurnal (10%)	4					4
b. Ruang lingkup dan kedalaman pembahasan (30%)	12					11,9
c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	12					11,6
d. Kelengkapan unsur dan kualitas penerbit (30%)	12					11,7
Total = (100%)	**40**					39,2
Kontribusi Pengusul (Penulis anggota)	40% × 39,2 : 4 = 3,92					

Komentar Peer Review:

a. **Kelengkapan dan kesesuaian unsur:** Penulisan artikel sudah mengikuti author guideline yang berlaku meliputi Title, Introduction, Experimental, Results and Discussion, Conclusion, Declarations, References. Setiap poin

dalam artikel memiliki relevansi yang baik sehingga alur pembahasan mengalir. Topik dari penelitian sesuai dengan bidang para penulis.

b. **Ruang lingkup dan kedalaman pembahasan:** Ruang lingkup dari Heliyon adalah ilmu pengetahuan khususnya sains, dan salah satunya adalah ilmu kimia. Penelitian tentang sintesis, karakterisasi dan uji kemampuan transfer proton termasuk ke dalam ruang lingkup tersebut. Proses sintesis copolymer eugenol-allyleugenol tersulfonasi dijelaskan cukup mendalam melalui reaksi kimia yang disajikan serta penjelasannya. Data hasil uji juga disajikan secara komprehensif. Sebanyak 50 jurnal yang digunakan sebagai referensi menunjukkan bahwa artikel ditulis dengan studi pustaka yang detail.

c. **Kecukupan dan kemutahiran data/informasi dan metodologi:** Penyajian data berupa 18 figures yang dilengkapi dengan pembahasan mendalam sangat mendukung hasil penelitian. Terlebih lagi data uji disajikan dalam bentuk diagram batang memudahkan pembaca untuk memahami hasilnya. Karakterisasi yang dilakukan cukup banyak dan sesuai kebutuhan, yaitu FTIR, H-NMR, LCR meter, TGA-DSC, dan viscometer. Sebanyak 78% artikel sebagai rujukan dengan usia tidak lebih dari sepuluh tahun menunjukkan kedalaman dan kemutakhiran pembahasan.

d. **Kelengkapan unsur dan kualitas penerbit:** Artikel ini dipublikasikan pada jurnal Heliyon yang diterbitkan oleh Elsevier yang menempati posisi quartile Q1 dengan nilai SJR = 0,61. Tidak ditemukannya kesalahan dalam penulisan menunjukkan bahwa proses editorial dilakukan dengan baik menghasilkan artikel yang berkualitas. Turnitin: 15% mengindikasikan tidak adanya plagiasi dalam paper ini.

Semarang, 15 Mei 2023
Reviewer 2

Ismiyarto, S.Si., M.Si., Ph.D.
NIP. 196910111997021001

Unit kerja :
Departemen Kimia FSM Undip
Jabatan Fungsional: Lektor Kepala

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Volume 8, Issue 12, December 2022, e12401

Research article

Synthesis and characterization of sulfonated poly(eugenol-co-allyleugenol) membranes for proton exchange membrane fuel cells

Ngadiwiyana [a], Gunawan [a], Nor B.A. Prasetya [a], Tutuk D. Kusworo [b], Heru Susanto [b]

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https://doi.org/10.1016/j.heliyon.2022.e12401

Abstract

The research of sulfonated eugenol-allyleugenol copolymer (SPEAE) based membrane for fuel cell from eugenol derivate had been conducted. First, eugenol was reacted with various weights of allyl eugenol to form eugenol-allyleugenol copolymer (PEAE). Determination of the optimum composition of PEAE was done by testing the swelling properties. Then, PEAE was sulfonated using concentrated sulfuric acid with time variations of 1, 2, 3, 4, and 5 h to form SPEAE. The SPEAE produced was tested for the degree of sulfonation, water uptake, cation exchange capacity, and membrane proton conductivity. In addition, the characteristics of the PEAE and SPEAE copolymer membranes were also analyzed using FTIR spectrophotometers, 1H-NMR, TGA, and DSC. The results showed that the copolymerization of eugenol:allyleugenol (EG:AEG) with a ratio of 10:1 gave the lowest swelling degree. The best SPEAE copolymer was obtained from sulfonation for 2 h with yield, degree of sulfonation, water absorption value, proton conductivity, and cation exchange capacity of 90.6%, 12.87%, 50.7%, 1.83×10^{-5} S cm^{-1} and 0.356 meq/g, respectively. FTIR analysis shows the formation of PEAE with the loss of the vinyl eugenol groups used to form the polymer and shows the formation of SPEAE in the presence of sulfonate groups from the sulfonation reaction. ^{1}H-NMR also confirmed the presence of the PEAE and SPEAE copolymers. In addition, analysis of thermal properties with TGA and DSC also showed that sulfonate treatment could improve membrane stability.

Previous Next

Keywords

Allyleugenol; Copolymer; Eugenol; Fuel cell; Sulfonation

Aims and scope

Editors and staff

Editors and staff

24 May 2023

Heliyon editors and staff

For biographical details about our editors and staff, please see our editors and staff page. For a detailed listing of our advisory board, please see our advisory board page.

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Volume 8, Issue 12

December 2022

Previous vol/issue Next vol/issue

Research article *Open access*

Insight into thermo-mechanical enhancement of polymer nanocomposites coated microsand proppants for hydraulic fracturing

Mohan Raj Krishnan, Haneen Omar, Yazeed Aldawsari, Bayan Al Shikh Zien, ... Edreese H. Alsharaeh

Article e12282

View PDF Article preview

Abstract

Abstract

radical initiator azobisisobutyronitrile (AIBN). The outer layer was prepared by mixing epoxy resin, a cross-linker, and commercial graphene (CG) followed by thermally curing the mixture. The dual-coated microsand proppants exhibited enhanced mechanical characteristics of

Research article *Open access*

The impact of the COVID-19 pandemic on a surgical PICU in China that did not admit COVID-19 patients

Geng Zhang, Xuepeng Zhang, Hua Yao, Yue Zhou, ... Siyuan Chen

Article e12517

View PDF Article preview

Abstract

2021. We explored the impact of the COVID-19 outbreak on PICU admission characteristics by including all patients younger than 18 years admitted to the PICU between January 23 and April 8 in 2020 and those admitted in the same time periods in prepandemic years (2018 and 2019) and in 2021.

Results

The percentage of patients admitted to the PICU from the Chengdu region increased from 34.2 percent in 2019 to 40.4 percent in 2020, whereas that from other provinces decreased from 11.7 percent in 2019 to 5.8 percent in 2020 ($P = 0.012$). The median length of stay (LOS) in the PICU was significantly longer in the 2020 cohort (4.0 days) than in the 2019 cohort (2.0 days) (P < 0.001); the median hospital LOS was also significantly longer in the former (12.0 days) than in

Research article *Open access*

A fat fraction phantom for establishing new convolutional neural network to determine the pancreatic fat deposition

John Zhiyong Yang, Rinki Murphy, Jun Lu

The determination of fat fraction based on Magnetic Resonance Imaging (MRI) requires extremely accurate data reconstruction for the assessment of pancreatic fat accumulation in medical diagnostics and biological research. In this study, the signal model of the oil and water emulsion was created with a 3.0 T field strength. We examined the quantification of the fat fraction from phantom and the intrapancreatic fat fraction using the techniques of magnetic resonance spectroscopy (MRS) and Iterative Decomposition with Echo Asymmetry and Least-Squares estimate (IDEAL) in magnetic resonance imaging (MRI). Additionally, we contrasted expert manual pancreatic fat assessment with MRS and IDEAL pancreatic fat fraction quantification. There was a strong connection between the true fat volume fraction

Case report *Open access*

Severe hypertrophic cardiomyopathy in a patient with a homozygous MYH7 gene variant

Walter Serra, Giulia Vitetta, Vera Uliana, Federico Barocelli, ... Antonio Percesepe

Article e12373

View PDF Article preview

Abstract

the interventricular septum.

Case presentation During a sports medicine control, a ultrasound scan in a 17 years old patient has shown a concentric left ventricular parietal hypertrophy associated with a 23 mm mid- basal interventricular septum thickness. After genetic counselling, a positive family

Research article *Open access*

Novel high precision low-cost dual axis sun tracker based on three light sensors

Youssef Boukdir, Hamid EL Omari
Article e12412

View PDF Article preview

Abstract

Abstract

This study aims to test a new type of dual axes solar tracker based on just three Light Dependent Resistors (LDR) as optical sensors in order to achieve a high precision sun tracking that satisfies the requirements of solar concentration systems. This new system is integrated into a solar concentrator that uses a set of Fresnel mirrors and an evacuated tube collector as an absorber so that it can be used as a solar water heater. The 3D-printed support that holds LDRs have three compartments to maintain the three LDRs firmly in their place. One is placed on the left and the other on the right side of the support. These two LDRs are responsible for the azimuthal tracking while the third LDR is placed in the center and its responsibility is elevation tracking. This central LDR is covered under an alveolus hollow tube

Research article *Open access*

Effects of chronic tamoxifen treatment in female rat sexual behaviour

Cláudia A. Pinto, Bruno M. Fonseca, Susana I. Sá

The medial preoptic (MPN) and the ventromedial hypothalamic nuclei (VMN) modulate the estrogen receptor (ER)-dependent female sexual behavior, a response that is inhibited by tamoxifen (TAM), a modulator of the steroid receptor activation. With the objective to assess TAM action in the brain areas involved in the modulation sexual cues, an animal model on long-term TAM therapy to intact female rats, was used to mimic the 5-year prophylactic TAM therapy offered to women at higher risk of breast cancer. After three months treatment, female sexual behavior with a stud male rat was evaluated. Upon sacrifice, the brains were removed and the MPN and the ventrolateral division of the VMN were screened for the effects of TAM in the expression of ERα, ERβ and progesterone receptor. Results show that TAM inhibited the

Review article *Open access*

Effectiveness of myofascial therapy on hemophilic arthropathy: A systematic review and meta-analysis of clinical trials

Sezaneh Haghpanah, Mohsen Razeghi, Mehrab Sayadi, Mani Ramzi, ... Mahnaz Hosseini-Bensenjan

Article e12552

Abstract

To summarize the existing evidence of the effects of myofascial therapy (MFT) on joint status, joint pain, and hemarthrosis in hemophilic arthropathy.

Methods

Research article *Open access*

Value of thiol and ischemia modified albumin (IMA) in predicting mortality in serious COVID-19 pneumonia

Tarik Acar, Birsen Ertekin, Mehmet Yortanli

Article e12514

View PDF Article preview

Abstract

Abstract

Background/aim

Viral infections of the respiratory tract are generally related to many factors such as excessive production of cytokines, inflammation, cellular death, redox imbalance or oxidative stress. The aim of this study was to determine the serum levels of thiol and IMA in patients with severe COVID-19 pneumonia to evaluate oxidative stress.

Study design

This was a prospective, sectional cohort study conducted at a pandemics hospital between

Research article *Open access*

Abstract

Abstract

Indian mustard is an economic and highly important industrial oilseed crop. In this study, genetic diversity among 135 Indian mustard germplasm accessions was evaluated using 11 agro-morphological descriptors and 227 SSRs. Morphological characterization of Indian mustard germplasm accessions exhibited a broad range of variation for characters including biological yield (CV = 25.63%), seed yield (CV = 23.23% and 1000-seed weight (CV = 23.14%); whereas traits such as days to maturity (CV = 2.91%) showed lowest degree of variation. Out of 227 SSR markers evaluated, a total of 159 (70.04%) SSRs produced polymorphic products and 68 (29.96%) SSRs resulted into monomorphic amplicons. The polymorphic markers amplified 575 alleles and the number of alleles ranged from 2-7 with 3.61 average number of alleles per

Research article *Open access*

Evaluating the effects of environmental management practices on environmental and financial performance of firms in Malaysia: the mediating role of ESG disclosure

Qaisar Ali, Asma Salman, Shazia Parveen

Article e12486

View PDF Article preview

Abstract

Abstract

The concepts of environmental and business sustainability are well-established in the business lexicon of progressive firms. However, firms are yet to examine the effects of environmental management practices (EMPs) on environmental performance (EP) and financial performance (FP) by connecting the missing linkage of environment, social, and governance disclosure (ESGD). This study analyses the impact of EMPs on EP and FP and

Utilization of nano volcanic ash as a natural economical adsorbent for removing cadmium from wastewater

Shoroog Alraddadi
Article e12460

View PDF Article preview

Abstract

Abstract

The physical properties of volcanic ashes (pumice and scoria) differ based on the locations and historical conditions of the volcanic eruptions, affecting their utilization in applications. In this study, the effectiveness of nano volcanic ash from Al Jabal Al Abyad in eliminating cadmium from aqueous solutions was investigated. Volcanic ash powder was initially milled using a high-energy ball mill to obtain particles with sizes of approximately 500 and 100 nm that were used as adsorbents. The mineralogical and physicochemical properties of the volcanic ash powder were determined using X-ray fluorescence spectroscopy, X-ray diffraction, Raman spectroscopy, and Barrett–Joyner–Halenda analysis. Then, the characteristics of cadmium adsorption (from an aqueous solution) on the volcanic ash powder and nano

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Investigation on the effect of cotton-tencel (50:50) siro yarn twist multipliers on fabric stiffness

Farhana Afroz, Mohammad Mamunur Rashid, MD. Momtaz Islam, Shilpi Akter
Article e12498

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Abstract

Abstract

and the flexural rigidity of woven fabrics. The 1/1 plain, 2/2 twill, and 8-end satin fabrics have been woven using prepared yarns in warp and weft directions. The fabric stiffness has been measured using the ASTM D1388-2018 method. The results reveal that fabric stiffness

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Integrative structural and functional analysis of human malic enzyme 3: A potential therapeutic target for pancreatic cancer

Tsehai A.J. Grell, Mark Mason, Aaron A. Thompson, Jose Carlos Gómez-Tamayo, ... Xiaodi Yu

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Abstract

Malic enzymes (ME1, ME2, and ME3) are involved in cellular energy regulation, redox homeostasis, and biosynthetic processes, through the production of pyruvate and reducing agent NAD(P)H. Recent studies have implicated the third and least well-characterized isoform, mitochondrial $NADP^+$-dependent malic enzyme 3 (ME3), as a therapeutic target for pancreatic cancers. Here, we utilized an integrated structure approach to determine the structures of ME3 in various ligand-binding states at near-atomic resolutions. ME3 is captured in the open form existing as a stable tetramer and its dynamic Domain C is critical for activity. Catalytic assay results reveal that ME3 is a non-allosteric enzyme and does not require modulators for activity while structural analysis suggests that the inner stability of ME3 Domain A relative to

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Synthesis and characterization of sulfonated poly(eugenol-co-allyleugenol) membranes for proton exchange membrane fuel cells

Ngadiwiyana, Gunawan, Nor B.A. Prasetya, Tutuk D. Kusworo, Heru Susanto

The research of sulfonated eugenol-allyleugenol copolymer (SPEAE) based membrane for fuel cell from eugenol derivate had been conducted. First, eugenol was reacted with various weights of allyl eugenol to form eugenol-allyleugenol copolymer (PEAE). Determination of the optimum composition of PEAE was done by testing the swelling properties. Then, PEAE was sulfonated using concentrated sulfuric acid with time variations of 1, 2, 3, 4, and 5 h to form SPEAE. The SPEAE produced was tested for the degree of sulfonation, water uptake, cation exchange capacity, and membrane proton conductivity. In addition, the characteristics of the PEAE and SPEAE copolymer membranes were also analyzed using FTIR spectrophotometers, 1H-NMR, TGA, and DSC. The results showed that the copolymerization of

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Assessment of ELISA-based method for the routine examination of serum indoxyl sulfate in patients with chronic kidney disease

Shuangdi Duan, Jiayi Pi, Chun-Hsiang Wang, Yi-Chou Hou, ... Hung-Yu Sun

Article e12220

Abstract

examinations.

Methods

The efficiencies of three commercial ELISA kits in determination of serum IS were validated

Research article *Open access*

Exploring combinations of grafting time and scion cultivar in walnut grafting success under open field condition

Chiranjivi Sharma, Rabin Thapa, Krishna Prasad Thapaliya, Madhu Sudhan Ghimire, Himal Adhikari

Article e12485

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Abstract

Abstract

Long juvenile period, hard shelled nature of fruit of seed propagated plants, difficulty in grafting and poor success rate has been the major concerns in walnut production in the world. Our study will aid in standardization of suitable techniques for multiplication of high yielding varieties so as to escalate the competitiveness in the international market. Hence, this study was rendered to determine the impact of scion cultivar as well as grafting time in walnut in Jumla district, Nepal in 2021. Hartley and Payne cultivars of walnut together with four disparate grafting dates viz. 14th March, 21st March, 28th March, and 4th April were employed as treatments and the entire analysis was set down in two factorial randomized complete block design (RCBD). Twenty grafted plants were defined per treatment for the investigation and

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Research Article

Huseyin Ozan Tekin*, Ghada ALMisned, Gulfem Susoy, Hesham M. H. Zakaly, Shams A. M. Issa, Gokhan Kilic, Yasser Saad Rammah, Gandham Lakshminarayana, Antoaneta Ene*

A detailed investigation on highly dense CuZr bulk metallic glasses for shielding purposes

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Abstract: Gamma-ray shielding properties of eight different metallic glasses based on CuxZr100-x: x = 35 (Cu35Zr65) – 70 (Cu70Zr30) were determined using Monte Carlo simulations and Phy-X/PSD software. A typical gamma-ray transmission setup has been modeled in MCNPX Monte Carlo code. The general trend of the linear attenuation coefficients (μ) was reported as $(\mu)_{Cu35Zr65} < (\mu)_{Cu40Zr60} < (\mu)_{Cu45Zr55} < (\mu)_{Cu50Zr50} < (\mu)_{Cu55Zr45} < (\mu)_{Cu60Zr40} < (\mu)_{Cu65Zr35} < (\mu)_{Cu70Zr30}$. In terms of half value layer (HVL) values, the Cu35Zr65 sample has the highest value (2.984 cm) and the Cu70Zr30 sample has the lowest value (2.769 cm) at 8 MeV photon energy. The mean free path (MFP) values were 4.305 and 3.995 cm for Cu35Zr65 and Cu70Zr30 samples, respectively. Generally, MFP and HVL values of the studied glasses were reported as $(MFP,HVL)_{Cu35Zr65} > (MFP,HVL)_{Cu40Zr60} > (MFP,HVL)_{Cu45Zr55} > (MFP,HVL)_{Cu50Zr50} > (MFP,HVL)_{Cu55Zr45} > (MFP,HVL)_{Cu60Zr40} > (MFP,HVL)_{Cu65Zr35} > (MFP,HVL)_{Cu70Zr30}$ for all photon energy range. The Cu70Zr30 sample showed maximum values of both the effective conductivity (C_{eff}) and effective electron density (N_{eff}). In addition, the Cu70Zr30 sample has minimum exposure and energy absorption buildup factor (EBF and EABF) values at all studied gamma-ray energies. The results revealed that the Cu70Zr30 sample has superior attenuation properties among all studied samples.

Keywords: metallic glasses, radiation shielding, Phy-X PSD, buildup factors

*** Corresponding author: Huseyin Ozan Tekin,** Medical Diagnostic Imaging Department, College of Health Sciences, University of Sharjah, Sharjah 27272, United Arab Emirates; Istinye University, Faculty of Engineering and Natural Sciences, Computer Engineering Department, Istanbul 34396, Turkey, e-mail: tekin765@gmail.com
*** Corresponding author: Antoaneta Ene,** INPOLDE Research Center, Department of Chemistry, Physics and Environment, Faculty of Sciences and Environment, Dunarea de Jos University of Galati, 47 Domneasca Street, 800008 Galati, Romania, e-mail: Antoaneta.Ene@ugal.ro
Ghada ALMisned: Department of Physics, College of Science, Princess Nourah Bint Abdulrahman University, P.O. Box 84428, Riyadh 11671, Saudi Arabia
Gulfem Susoy: Department of Physics, Faculty of Science, Istanbul University, Istanbul 34134, Turkey
Hesham M. H. Zakaly: Institute of Physics and Technology, Ural Federal University, 620002 Ekaterinburg, Russia; Physics Department, Faculty of Science, Al-Azhar University, Assiut 71524, Egypt
Shams A. M. Issa: Physics Department, Faculty of Science, Al-Azhar University, Assiut 71524, Egypt; Physics Department, Faculty of Science, University of Tabuk, Tabuk 47512, Saudi Arabia
Gokhan Kilic: Department of Physics, Faculty of Science and Letters, Eskisehir Osmangazi University, Eskisehir, TR-26040, Turkey
Yasser Saad Rammah: Department of Physics, Faculty of Science, Menoufia University, Shebin El-Koom 32511, Menoufia, Egypt
Gandham Lakshminarayana: Intelligent Construction Automation Center, Kyungpook National University, 80, Daehak-ro, Buk-gu, Daegu, 41566, Republic of Korea

1 Introduction

Bulk metallic glasses (BMGs), also known as amorphous metals, have been studied since they were first produced in the 1960s. Since then, different types of research on their physical and structural characteristics, as well as production changes, have been conducted. In comparison to traditional metals, where atoms are arranged in a repeated pattern of crystals or grains of various sizes and shapes, BMGs have a random and disordered atomic structure. BMG's competitive physical characteristics such as strength, durability, hardness, elasticity, corrosion and wear resistance are enhanced by this amorphous structure, which is free of grain defects [1]. After a breakthrough at the end of the 1980s and the beginning of the 1990s, BMGs drew the attention of the materials science community. Using various casting and water-cooling processes, the high glass-forming ability (GFA) of some alloys permitted the creation of BMGs up to about 80 mm in size. New BMG forming alloys based on Zr, La, Ti, Ni, Pd, Mg, Al, Fe, and Cu have been developed during the

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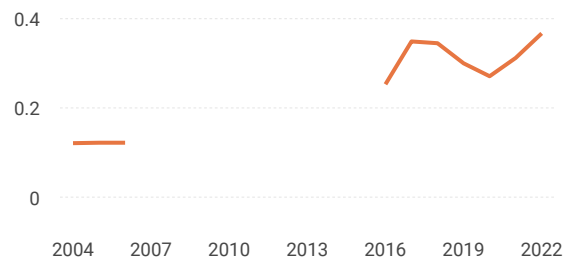

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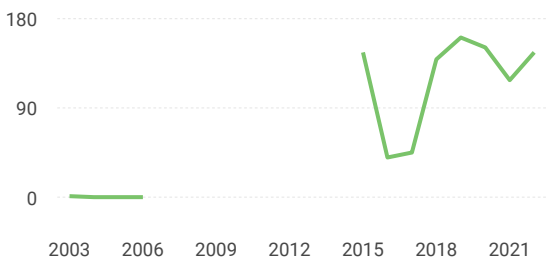

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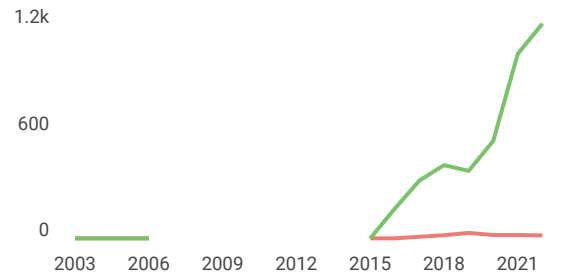

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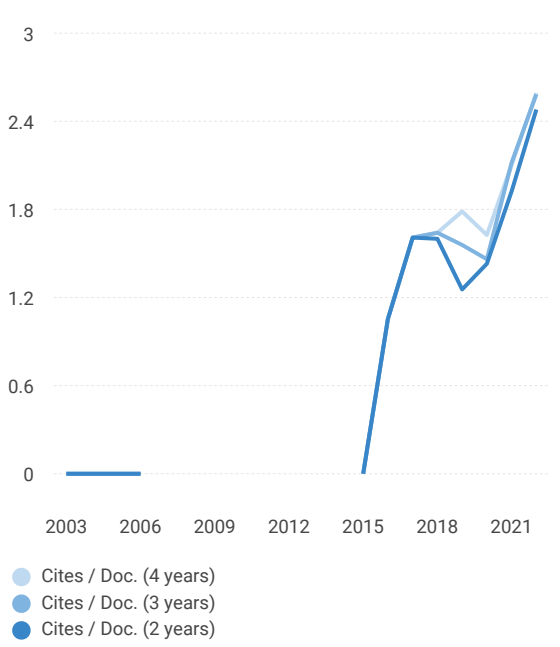

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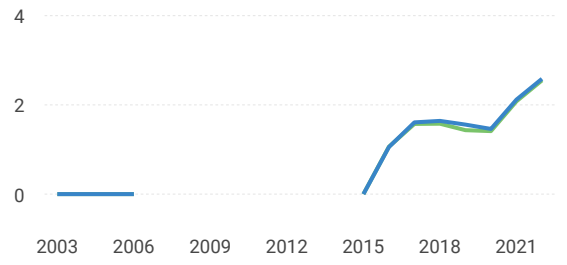

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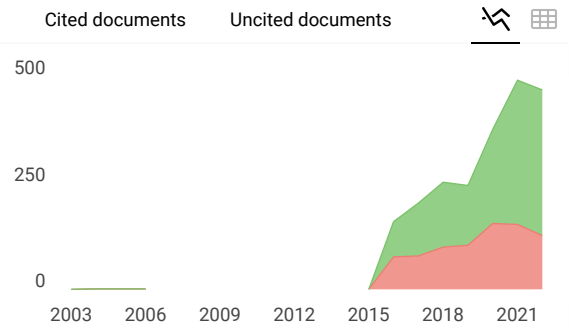

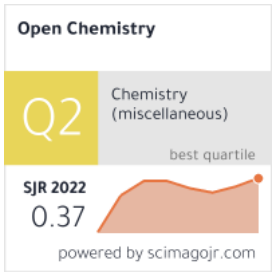

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