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# PROSIDING SNTTM XXIII

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Publikasi artikel ilmiah hasil penelitian dosen, mahasiswa, dan peneliti bidang teknik mesin yang diseminarkan pada Seminar Nasional Tahunan Teknik Mesin.

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The Mechanical Engineering Cooperation Agency

## PREFACE

The Mechanical Engineering Cooperation Agency (BKS-TM Indonesia) has established the International Symposium on Advances and Innovation in Mechanical Engineering (ISAIME) and the Seminar Nasional Tahunan (SNTTM) as annual scientific forums for academics, researchers, and practitioners in mechanical engineering. Both the 6<sup>th</sup> ISAIME and SNTTM XXIII (2025) were convened on 9 October 2025, organized by the Mechanical Engineering Study Program, Faculty of Engineering, Mechanical Engineering Department, Universitas Andalas, Padang, Indonesia, with the theme “Artificial Intelligence and Sustainability in Mechanical Engineering: Smart Solution for a Greener Future.”



This symposium and seminar served as a platform for presenting and discussing recent advances, research findings, and innovations across a wide range of topics, including mechanical application design, energy conversion, manufacturing processes, materials engineering, and mechanical engineering education. Distinguished experts delivered a total of two keynote lectures from Universiti Teknologi Malaysia and the Université Laval, Canada, while 112 ISAIME papers and 93 SNTTM papers were presented and grouped into four thematic areas: mechanical application design, energy conversion, manufacturing processes, and materials engineering. These contributions reflect the growing role of mechanical engineering in advancing technological innovation, environmental sustainability, and human resource development within Industry 4.0.

The Organizing Committee gratefully acknowledges the sponsorship and support of various companies and partner institutions, as well as the commitment of all speakers, authors, and participants who contributed to the success of this event. The knowledge and insights shared during the 6<sup>th</sup> ISAIME and SNTTM XXIII are expected to foster academic collaboration, strengthen networks between academia and industry, and advance science and technology in mechanical engineering.

Depok, 9 March 2026  
Sekretaris Jenderal BKS-TM Indonesia





Prof. Dr. Ir. Ario Sunar Baskoro, S.T., M.T., M.Eng.

## Welcoming remarks by the chairman of the ISAIME and SNTTM (2025)



It is our distinct privilege and profound honor to present the proceedings of Seminar Nasional Tahunan Teknik Mesin (SNTTM XXIII) 2025.

In 2025, the Mechanical Engineering Department at the Engineering Faculty of Universitas Andalas (UNAND) in Padang, West Sumatra, is hosting the event and welcoming participants who have gathered at the Santika Hotel in Padang on 9 October 2025. We are also accommodating participants from around the world through online meetings.

Seminar Nasional Tahunan Teknik Mesin (SNTTM XXIII) is an international conference initiated by the Mechanical Engineering Cooperation Agency (BKSTM), a national organization of Indonesian mechanical engineering. The event brings together researchers, scientists, and engineers from academia and industry to present and exchange ideas, with a focus on advances in mechanical engineering and technology.

The central theme of this year's conference is "Artificial Intelligence and Sustainability in Mechanical Engineering: Smart Solutions for a Greener Future, encompassing a forward-looking agenda for the field of Mechanical Engineering, positioning Artificial Intelligence as the primary tool for achieving sustainability goals. It's an urgent call to action to move beyond traditional mechanical design toward digitally optimized, environmentally sound practices.

We received approximately 93 high-quality research papers from highly dedicated researchers. These selected papers were presented during the conference. We extend our heartfelt gratitude to our distinguished keynote and invited speakers, including: (1) Professor Siti Zaiton from Universiti Teknologi Malaysia, and (2) Professor Dr. Hendra Hermawan from Université Laval, Canada.

We also wish to express our deep appreciation to the event's committee, who have worked hard in the last few months, to ensure the event runs smoothly and efficiently. Our deepest thanks to the Head of the Mechanical Engineering Department, the Dean of the Engineering Faculty, and the Rector of Universitas Andalas for their unwavering support throughout the conference and publication process.

Sincerely,

Assoc. Prof. Dr. Ir. Oknovia Susanti, S.T., M.Eng.  
Conference Chair of ISAIME and SNTTM 2025



## **Sustainable Intelligence: Harnessing AI to Engineer a Greener Future**

Prof. Dr. Siti Zaiton Mohd Hashim  
Intelligent Informatics Research Group  
Faculty of Computing, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor

Artificial Intelligence (AI) and mechanical engineering are coming together to tackle some of the world's biggest challenges, including climate change, rising energy needs, and the push to use resources more wisely. As we move toward a more sustainable future, engineers are expected to design and operate systems that are not only efficient but also environmentally friendly. This talk will highlight how AI can act as a powerful tool to support green goals in mechanical engineering through more innovative design, energy savings, and cleaner transport solutions. Examples include AI helping to design lighter, stronger, and recyclable parts that reduce material waste, as well as using machine learning to predict when machines need repair before they break down. Digital twin technology: virtual models of real systems allow us to test and improve energy use in real time. In energy applications, AI makes air conditioners, motors, and renewable energy systems more efficient, thereby reducing carbon emissions. In transport, AI improves battery performance in electric vehicles, supports hydrogen fuel systems, and helps reduce emissions in mobility. The presentation will also feature efforts in Malaysia and Indonesia, including energy transition plans, innovative grid projects, and the use of digital twins, demonstrating how local innovation can drive sustainability. While AI offers great promise, it also poses challenges such as data quality, skills gaps, and the energy demands of computing. This calls for "Green AI, using AI responsibly and efficiently. The keynote highlights engineers as champions of sustainability, showing how AI can help design more intelligent systems, run them more effectively, and build solutions that benefit both people and the planet.

Keywords: AI, Sustainability, Mechanical Engineering, Digital Twin, Green Mobility



## **Electrochemical and surface characterization of TiHfZrNbx high-entropy alloys as bipolar plates for proton exchange membrane water electrolyser**

Prof. Dr. Hendra Hermawan  
Université Laval

A proton exchange membrane water electrolyser (PEMWE) has been identified as a promising technology for producing high-purity hydrogen using renewable energy sources with zero carbon emissions. One of PEMWE's core components is the bipolar plate, which is critical for providing mechanical support, gas circulation, and thermal and electrical conduction, and accounts for ~50% of its construction cost. Considering PEMWE's harsh operating environment – high overpotential (1.6-2.0 V), strong acidity (pH 2-4), and high temperature (60-80 °C) – bipolar plates must have an excellent corrosion resistance. Titanium is often used as the plate material, but its oxide film is prone to fluoride attack, reducing corrosion resistance and the plate's service life. The present work studied the corrosion resistance of TiHfZrNbx ( $x = 0.2, 0.3,$  and  $0.4$ ) high-entropy alloys (HEAs) in  $0.5 \text{ M H}_2\text{SO}_4 + 5 \text{ ppm F}^-$  solution at  $70 \text{ }^\circ\text{C}$ , employing electrochemical-impedance spectroscopy (EIS), cyclic- and static-polarizations (CPP, PSP), SEM, AFM, XPS, and MP-AES. Results from EIS and CPP evaluation revealed the HEAs exhibited ~600 times higher polarization resistance than CP-Ti, with the highest achieved at  $79.57 \text{ k}\Omega\cdot\text{cm}^{-2}$  for TiHfZrNb $_{0.2}$  vs.  $0.1 \text{ k}\Omega\cdot\text{cm}^{-2}$  for the CP-Ti, leading to a sharp contrast in the corrosion-current density,  $805.11 \text{ }\mu\text{A}\cdot\text{cm}^{-2}$  for the CP-Ti vs.  $0.92 \text{ }\mu\text{A}\cdot\text{cm}^{-2}$  for the TiHfZrNb $_{0.2}$ , reflecting a far superior corrosion resistance of the HEAs. The XPS analysis confirmed the formation of multi-oxide passive film, predominated by  $\text{HfO}_2 > \text{ZrO}_2 > \text{TiO}_2$ , with a presence of  $\text{Nb}_2\text{O}_5$  only in TiHfZrNb $_{0.4}$ , all of which possess an n-type semiconducting characteristic and a much lower electron-donor concentration in the HEAs than in the CP-Ti. The complementary analyses of PSP, SEM, AFM, and MP-AES highlighted the synergistic effects of Hf, Zr, and Nb in enhancing the protective properties of the passive film. Still, the absence of  $\text{Nb}_2\text{O}_5$  on the top surface of TiHfZrNb $_{0.2}$  and TiHfZrNb $_{0.3}$  indicated a minor role for Nb in passivation.

**Thursday, 9 October 2025**  
**Hotel Santika Premiere Padang**

<b>07:30 – 08:30</b>	<b>REGISTRATION</b>
<b>08:30 – 09:30</b>	<b>Opening and Welcome Speech</b>
<b>09:30 – 10:50</b>	<b>Plenary Session – Keynote 1: Prof. Siti Zaiton binti Mohd Hashim</b>
<b>09:50 – 10:30</b>	<b>Break</b>
<b>10:30 – 10:45</b>	<b>Keynote 2: Prof. Dr. Hendra Hermawan</b>
<b>10:45 – 12:30</b>	<b>Parallel Session: ISAIME 2025 &amp; SNTTM XXIII</b>
<b>12:30 – 13:30</b>	<b>ISHOMA</b>
<b>13:30 – 15:00</b>	<b>Parallel Session: ISAIME 2025 &amp; SNTTM XXIII</b>
<b>15:00 – 16:00</b>	<b>Closing Ceremony</b>

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2	107	A Review: Thermoelectric Cooler Application for Portable Beverage Cooler	N Fuad	Design and Advanced Mechanics
3	28	Aerodynamic effect of windbreak on the crosswind phenomenon on a high-speed train	Harinaldi Harinaldi	Energy
4	81	Analisis Hambatan Kapal Bulk Carrier Skala Model dan Skala Penuh Menggunakan Simulasi CFD dan Formula Empiris	Kurniawan Teguh Waskito	Energy
5	37	Analisis Kekasaran Permukaan Tulang Pada Pemesinan Freis Menggunakan Metode Taguchi	Gusri Akhyar Ibrahim	Manufacturing
6	68	Analisis Kinerja Turbin Vortex dengan Variasi Sudu Biomimetik Berbentuk Rumah Keong	Iwan Kurniawan	Energy
7	86	Analisis Multi-Kriteria Bahan Bakar Rendah Sulfur untuk Mesin Diesel Kapal Tanker: Kinerja, Emisi, dan Biaya	Muhammad Arif Budiyanto	Energy
8	64	Analisis Pengaruh Penggunaan Genset Tambahan terhadap Konsumsi Bahan Bakar pada Kapal Ro-Ro 3500 DWT	Dimas Angga Fakhri Muzhoffar	Energy
9	110	Analisis Proses Lost PLA Casting untuk Manufaktur Propeller Kapal Cepat Tanpa Awak melalui Studi Dummy dengan Material Timah	Moh Nor Ali Aziz	Manufacturing
10	83	Analysis and optimization of aerodynamics on the electric yellow bus of PT Mobil Anak Bangsa	Wahyu Nirbitto	Energy
11	58	Analysis of Bolted Joint Loosening Due to Structural Vibrations using Short-Time Fourier Transform and Wavelet Transform	Rahmatsyah Maksum Ramsi	Design and Advanced Mechanics
12	87	Analysis of co-firing palm oil waste for the economic and emission performance of PLTU in Riau	Aulia Ramadhan	Energy
13	62	Bell Casting Using Gema's Local Clay: Mold Performance and Gating Design Influence Variations	Dedy Masnur	Manufacturing
14	53	CFD2CFD: How Computational Fluid Dynamics (CFD) Can be A Means Towards Sustainable Conscious Field Dynamics (CFD)	M Hilman Gumelar Syafei	Mechanical Engineering Education
15	109	Characteristics of Hybrid Composites of Coconut Coir and Arenga Fibers on the Alkalization Process Using NaOH	Hesti Istiqlaliyah	Material Engineering
16	70	Coloring of master brake cover accessories (CNC products) using the anodizing method with natural mangosteen peel dye	Arif Budi Wicaksono	Manufacturing
17	89	Comparative Analysis of Oil, Water, and Solid Separation Performance Using a Three-Phase Decanter in Palm Oil Mills: Case Study at PKS A and B	M. Sabri	Energy
18	79	Comparative Performance of Submerged and Non-Submerged Pico-Scale Crossflow Water Turbine	Alifarsya Ihsan Maulana	Energy
19	125	COMPOSITE SOUND ABSORBER MADE FROM STYROFOAM AND COCONUT FIBER WASTE	Suardana Ngakan	Material Engineering
20	66	Design and Development of a Car Braking Characteristics Measurement Device Based on Ultrasonic and MPU6050 Sensors with IoT and GPS Data Acquisition	Hidayat Tullah Muhammad	Design and Advanced Mechanics
21	27	Design and development of a low-cost two-point bending tester for bamboo culm sheaths	Indraswari Kusumaningtyas	Material Engineering
22	84	Design and Fabrication of a Lumbar Interbody Fusion Spine Cage Combining Titanium and PEEK Materials	Yudan Whulanza	Design and Advanced Mechanics
23	80	Design and Implementation of TOF (Tool Open Fan) to Improve Maintenance Efficiency of Exhaust Fan in Gland Steam Condenser at Steam Power Plants	Deden Mamun Sajaah Deden	Energy
24	99	Design and thermo-mechanical analysis of a food packaging machine using ansys simulation	Rama Dani Eka Putra	Design and Advanced Mechanics
25	49	Design of a cyclone separator with circumfluent cyclone and convergent vortex finder for spray drying	Anis Aprilia	Energy
26	47	Design of smart food container using thermoelectric cooler and heatpipe integrated with internet of things	Adinda Diana Suci Istiqomah	Energy
27	54	Development of a microfluidic paper based with portable system for glucose concentration colorimetric analysis	Ridho Irwansyah	Energy

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29	93	Effect of Corrosion Growth on Aircraft Windshield Alloy Materials	Eka Irianto Bhifime	Material Engineering
30	101	Effect of Corrosion Rate and Hardness of Titanium in Kokubo's Simulated Body Fluid for Orthodontic Applications	Sanny Ardhy Sanny	Material Engineering
31	85	Effect of travel speed and arc length on geometry and heat accumulation in WAAM-GMAW process	Agus Sifa	Manufacturing
32	82	Evaluasi Keselamatan Kebakaran Kendaraan Bermotor	Yulianto Sulisty Nugroho	Energy
33	120	Evaluasi kinerja pengering hybrid berbasis pemanas listrik dan tungku biomassa untuk pengeringan biji kakao	Harmen	Energy
34	45	Experimental study of air blast freezing performance with 25 kg capacity cascade refrigeration system	Fayzil Auliaswan	Energy
35	48	Experimental study of freeze vacuum drying with thermal energy storage for drying 2kg aloe vera	Warits Adriyandy	Energy
36	46	Experimental study of green hydrogen production applied to gasoline engines with brake load capacity 0,25 kg/cm <sup>2</sup>	Suci Rahmadhani Irawan	Energy
37	34	Fuel Efficiency and Investment Feasibility of Marine Shaft Generator Installation: A Case Study on a Very Large Gas Carrier (VLGC)	Achmad Riadi	Energy
38	26	Impact of Ply Arrangement on the Mechanical Properties of Luffa Cylindrica/Fiberglass Reinforced Polyester Hybrid Composites	Wijang Wisnu Raharjo	Material Engineering
39	119	Impact of The Characteristics of The Flow Regimes and Dynamics of Coarse Particles Fly Ash in Circular Transportation Based On CFD-DEM	Yanuar	Energy
40	31	Implementasi Analytic Hierarchy Process (AHP) dalam Penentuan Bobot Key Performance Indicators (KPIs) pada Pembangkit Listrik Turbin Uap	Akbar Anggriawan	Energy
41	71	Investigation of chessboard scanning strategy in selective laser melting of ti6al4v	Amirah Salsabila Widad Putri	Manufacturing
42	114	IoT-Based Portable Weighbridge System for Over Dimension and Over Load (ODOL) Vehicle Monitoring	Muki Satya Permana	Design and Advanced Mechanics
43	127	Kaji Eksperimental Pengaruh Variasi Impeller Terhadap Kinerja Pump As Turbine (PAT)	Asral	Energy
44	97	Kaji Performa Mesin Refrigerasi Siklus Kompresi Uap dengan Refrigeran R134a dan Refrigeran Hidrokarbon sebagai Drop-in Substitute pada dengan Alat Ekspansi berbeda	Azridjal Aziz	Energy
45	67	Literature review Plate Heat Exchanger	Emil Mahfuzi	Energy
46	112	Manufacture IoT-Based Truck Weighbridge Development with Real-Time Wireless Monitoring	Muki Satya Permana	Manufacturing
47	69	Manufacturing of Duplex Stainless Steel using local material Ferronickel on Laboratory Scale	Ade Bagdja	Manufacturing
48	52	Mechanical behavior and damages testing under biaxial static-fatigue load of pre-impregnated composite plates from pla reinforced with ramie fibre in the development of lower limb prosthetics	Tresna Priyana Soemardi	Material Engineering
49	44	Optimalisasi Pembangkit Energi Surya dengan Teknologi Otomasi dan Artificial Intelligence	Mas Efendi	Design and Advanced Mechanics
50	65	Optimasi Pengurangan Massa Superstruktur dan Hatch Cover Kapal Ikan 5 GT	Gerry Liston Putra	Design and Advanced Mechanics
51	92	Optimizing the performance of gasoline-ethanol-methanol fueled engines with variations in the air-fuel ratio	Mokhtar	Energy
52	102	Pemanfaatan limbah serbuk gergajian kayu merbau (&int;intsia spp.&/i;) sebagai briket biomassa untuk energi rumah tangga	Pither Palamba	Energy
53	115	Pembuatan Paduan Logam Zr-Al-Cr-Ag untuk Material Implan	Muki Satya Permana	
54	95	Pengaruh Katalis Bentonit Terhadap Produksi Minyak Pada Pirolisis Sampah Plastik Low Density Polyethylene (LDPE)	Rahmat Iman Mainil	Energy

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56	29	Pengaruh Sisi Aliran Masuk Terhadap Prestasi Pompa Sebagai Turbin Dengan Jumlah Sudu Bervariasi	Asral	Energy
57	94	Pengaruh Variasi Kecepatan Terhadap Konsumsi Energi Baterai dan Efektivitas Daya pada Sepeda Motor Listrik	Wahyu Nirbito	Energy
58	73	Pengembangan Gear dengan Proses Additive Manufacturing berbasis Lattice Structure dengan Dimensi Variasional	Gandjar Kiswanto	Manufacturing
59	33	Perencanaan Pembangkit Energi Listrik Tenaga Ombak Sistem Osilator Pada Bagan Perahu Nelayan Perairan Tonyaman	Luther Sule	Energy
60	39	Potensi ekonomi sirkular dalam pengembangan kluster industri daur ulang kapal di indonesia	Sunaryo Sunaryo	Design and Advanced Mechanics
61	111	Process Modelling of Friction Stir Welding of AA1100 Aluminum Alloy Using a Hexagon-Shaped Tool to Optimize the Process Parameters	Indrawanto Indrawanto	Manufacturing
62	77	Production of Durian Seed Starch-Based Bioplastic Reinforced with Pineapple Leaf Fiber Cellulose	Putri Nawangsari	Design and Advanced Mechanics
63	96	Progress and Challenges of Grain Drying Technologies in Indonesia	Engkos Achmad Kosasih	Energy
64	113	Rancang Bangun Sistem Manajemen Energi Baterai Otomatis Untuk Cadangan Listrik Rumah Dengan Kapasitas 300Watt	Muki Satya Permana	Energy
65	124	Rangun bangun pengering gabah tipe rotary dryer kapasitas 25 kg	Endang Achdi	Energy
66	43	Sea Toll Route Optimization with Artificial Bee Colony Algorithm on Capacitated Vehicle Routing Problem	Gunawan	Design and Advanced Mechanics
67	121	Simulasi Termal Sistem Pemanas Selimut Fluida (Fluid Jacket) Pada Reaktor Torefaksi Kontinu Menggunakan Ansys-Fluent	Amrul Amrul	Energy
68	100	Sistem pendingin gedung 15.5 MWh dengan ice slurry CTES dan solar PV	Agus Sunjarianto Pamitran	Energy
69	88	Studi Distribusi Temperatur pada Tradisi Bakar Batu Papua sebagai Sistem Pemanasan Tradisional Multi Lapisan	Samuel Parlidungan Siregar	Energy
70	117	Studi numerik bantalan implan sendi pinggul dengan material CoCrMo terhadap UHMWPE berdasarkan indeks massa tubuh orang Indonesia	S. Sugiharto Sugih	Design and Advanced Mechanics
71	116	Studi numerik bantalan implan sendi pinggul dengan material SS316L terhadap UHMWPE berdasarkan indeks massa tubuh orang Indonesia	S. Sugiharto Sugih	Design and Advanced Mechanics
72	22	Syaiful Arif, Gunawarman, Syaiful Bakhri, Kusananto, Deni Mustika	Syaiful Arif	Material Engineering
73	105	Tahapan Dalam Desain Konseptual Mobil terbang Bersayap Tetap	Mohammad Adhitya	Energy
74	57	Techno-economic analysis of waste heat recovery on the Organic Rankine Cycle: a case study at Gunungsitoli gas engine power plant	Imansyah Ibnu Hakim	Energy
75	104	The Effect of Diameter-to-Basin Ratio on the Performance of a Pico-Scale Vortex Water Turbine	Budiarso	Energy
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32	82	Evaluasi Keselamatan Kebakaran Kendaraan Bermotor	Yulianto Sulisty Nugroho	Energy
33	120	Evaluasi kinerja pengering hybrid berbasis pemanas listrik dan tungku biomassa untuk pengeringan biji kakao	Harmen	Energy
34	45	Experimental study of air blast freezing performance with 25 kg capacity cascade refrigeration system	Fayzil Auliaswan	Energy
35	48	Experimental study of freeze vacuum drying with thermal energy storage for drying 2kg aloe vera	Warits Adriyandy	Energy
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44	97	Kaji Performa Mesin Refrigerasi Siklus Kompresi Uap dengan Refrigeran R134a dan Refrigeran Hidrokarbon sebagai Drop-in Substitute pada dengan Alat Ekspansi berbeda	Azridjal Aziz	Energy
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51	92	Optimizing the performance of gasoline-ethanol-methanol fueled engines with variations in the air-fuel ratio	Mokhtar	Energy
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