

Nurturing minds for a better world

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MAY 2024



IIT PALAKKAD

Sahyadri **TECH X PRESS**

REFLECTIONS OF IIT PALAKKAD



DISCOVER THE EXCELLENCE OF IIT PALAKKAD

AT A GLANCE

1300+
Students

100+
Faculty

80+
Staff

25
Advanced
Scientific Labs

1152
Research
Publications

11
Department
and Centres

14
Course Based
Programs

17
Research Based
Programs

85+
Crores(Rs)
Sponsored Projects

6+
Crores(Rs)
Consultancy Projects

The Indian Institute of Technology in Palakkad is an autonomous premier science and technology institute under the Ministry of Education, Government of India. Nestled in the Sahyadri mountain range, IIT Palakkad swiftly emerged as one among India's foremost hubs for engineering education. With unwavering dedication to academic brilliance and holistic growth, we champion the mantra of "Nurturing Minds for a Better World".

DIRECTOR'S DESK



Prof. Dr. A. Seshadri Sekhar

I take pride in presenting to you the second edition of our Institute newsletter, "Sahyadri TechXpress." It is double the joy as we have also accomplished a major milestone of shifting completely to our own permanent campus, Sahyadri, whilst Nila remains active. I am filled with immense pride for all the strides we have made and the accomplishments we have achieved as a community. This edition celebrates the spirit of innovation and academic excellence that defines our Institute. At IIT Palakkad, we believe in the transformative power of blending diverse cultural experiences with academic pursuits. From academic brilliance to exceptional performances in sports, arts, and community services, our students have consistently demonstrated their talent and commitment to excellence.

We have held a number of notable events in the last quarter, including seminars and workshops, all conducted in person. "Petrichor", the technocultural fest of IIT Palakkad, is our pride. It is not just a gathering of minds but a celebration of diversity and innovation. The outstanding performances by our students have earned them accolades and garnered praise and admiration from industry experts and peers alike. The "Open House" organized in association with Petrichor offered the public an opportunity to explore, interact and peek into life at IIT Palakkad.

Furthermore, the Institute hosted "Natyotsavam", which took students on an encapsulated journey through the rich history and culture of seven Indian classical dance forms. Sports and Athletics is all about fostering team teamwork, discipline, and a healthy spirit of camaraderie. Distinguished sports figures honored the First ever General Championship Mega Sports Gala of IIT Palakkad with their presence. With a total of 511 participants competing across 10 thrilling events, the campus buzzed with excitement.

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With each passing day, we are presented with new opportunities and challenges, and each story in our newsletter encapsulates our commitment to pushing the boundaries of knowledge and striving toward development. I extend my heartfelt gratitude to our fraternity for the unwavering support that they have rendered. I encourage you to explore the diverse array of articles in this edition and actively contribute to the success of our newsletter with your readership and constructive suggestions.

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LIMPSES



Natyotsavam - Showcase of 7 Spectacular Classical Dance Forms of India



Workshop on VLSI Design and Recent Trends Held at IIT



National Science Day Celebration



Second Indo-Norway Workshop on IN-SCOCOS



KSCSTE Tech Fest 2024



Unnat Bharat Abhiyan Regional Workshop on Localized Sustainable Development Goals



General Championship Mega Sports Gala



Chemistry Safety Workshop



National Science Day Celebration



Research Scholars' Day 2024



Chemistry Safety Workshop team



Pale Blue Dot Lecture on Public Engagement and History of Science



Petrichor and Open House 2024



Plumbing Apprentice Programme (PAP) conducted for natives of Attapadi



Industrial visit to the KSEB Kanjikode.



Workshop on Faculty Entrepreneurship



The Fourth Season of Science Quest

Deep Scan

THE 'ESSENCE' OF GREEN LIVING: NAVIGATING THE PATH TO SUSTAINABLE LIVING AND GREEN PRACTICE

The Environmental Sciences and Sustainable Engineering Centre (ESSENCE) is an interdisciplinary centre working to identify solutions to meet current requirements in a sustainable manner without jeopardizing the ability of future generations to meet their needs as well. The centre is a distinct platform that addresses contemporary issues in sustainability based on the requirements of local communities, the United Nations' sustainable development goals, and the Paris Climate Agreement. The centre is primarily focused on four key areas within increasingly complex and intertwined global environmental challenges.



Students at Miyawaki Forest site after the completion of work for their class project

The centre engages the academic community by offering courses in various domains of sustainability and sustainability assessment, organizing workshops and symposiums, and conducting research through sponsored and consultancy projects. The research program at ESSENCE admits students for postgraduate research from different specializations and provides opportunities to work on cross-disciplinary problems.

Technologies for resource recovery, material circularity, biomass valorisation, sustainable agriculture, renewable fuels and energy are being developed by the core team. Both experimental and numerical simulation-based problems are being tackled by the research students using cutting edge laboratory and advanced computing facilities.

A Miyawaki forest established within the campus of IIT Palakkad serves as a “living lab” to facilitate classroom teaching and research work. Additionally, facilities for studying photosynthesis and soil CO₂ respiration are in place to study the intimate link between climate change and plants, with a focus on climate change impact assessment on food security, bioenergy feedstocks, and the role of forests in climate change mitigation. An open-source software (R package BioCro) for modeling plant growth under climate change has been published recently. The first South India Plant Systems Modeling (SIPSM) workshop was organized in collaboration with ESSENCE at IIT Palakkad, IISER TVM, and IITM and witnessed participation from across India.



First South Indian Plant system modeling (SIPSM) workshop conducted jointly by ESSENCE@IITPKD, IISER TVM, and IITM

Meet **ESSENCE** faculty

- ◆ Dr. Deepak Jaiswal
- ◆ Dr. Sunitha Nayar
- ◆ Dr. Mintu Porel
- ◆ Dr. Divya PV
- ◆ Dr. Praveena Gangadharan
- ◆ Dr. Veena Venudharan
- ◆ Dr. Athira P
- ◆ Dr. Arun Rahul
- ◆ Dr. Sabarimalai Manikandan
- ◆ Dr. Sarmistha Singh
- ◆ Dr. R. Venkataraghavan



Interaction with the indigenous community of Wayanad to understand existing socio-economic problems and technological solutions for the same.

ESSENCE is working in collaboration with Keystone Foundation to study three distinct sites, namely Vellode Bird Sanctuary, Pichavaram Mangroves, and Nilgiri Forests, to quantify the ecosystem carbon stock, carbon sequestration potential, and their role in climate change mitigation as nature-based solutions. Other research projects being undertaken by ESSENCE faculty members include air quality monitoring, fertilizer production from source-separated urine, condition assessment and management of the Periyar river basin, the development of low-cost sensors for environmental monitoring and recycling, and the development of building materials with a reduced carbon footprint. Students and visiting researchers from other institutes and universities make use of the facilities for collaborative research, thesis projects, and summer internships. In addition to scientific research, social interventions and knowledge dissemination constitute major action points of the centre.

Through collaborative engagements with various non-governmental organizations and local government bodies the centre is developing monitoring studies as well as socio-ecological interventions.

The centre's outreach activities spearhead dialogue with the public at large on topics related to sustainable design and planning. The annual technical symposium on Advanced Technologies and Visionary Approaches to Sustainability (SATVA) conducted by the centre is one such initiative. Every year, the symposium selects a theme that engages with a pressing global concern. The sessions are meticulously designed to offer abundant opportunity for all participants to discuss, deliberate, and interact with one another, enabling them to acquire knowledge that may be applied to promote the 21st century imperative of sustainable living.



Panel discussion during SATVA 2024

Major Achievements by Students and Researchers

- ◆ Dr. Merlin Lopus and Haripriya won 2nd and 3rd best **Poster award at the SATVA 2024.**
- ◆ Sruthi Surendran is a recipient of the prestigious **PMRF fellowship.**
- ◆ Nandhana Sunil and Sruthi Surendran won the best **Poster award at the XVI Agricultural Sciences Congress, Kochi.**



PALAKKAD MATH CIRCLE: A SUSTAINED LEARNING SPACE PROMOTING MATHEMATICAL CULTURE

The Palakkad Math Circle is an IIT Palakkad outreach initiative in Palakkad and Chittur educational sub-districts. A welcoming, supportive and sustained learning space that promotes a mathematical culture, it is patterned along the lines of the original Math Circle pioneered overseas - an outreach program that brings professional mathematicians into direct contact with promising young mathematically-inclined minds. As of April 2024, Palakkad Math Circle has 60 high school students from 19 schools enrolled in the program.

Class 8 and 9 students identified and selected at the beginning of an academic year, meet every second Saturday and fourth Sunday of the month for a half-day session, and will continue to do so till the students complete Class 10. Multilingual sessions (in English/Malayalam/Tamil) with mentors, are held on our campus, with transportation from and to Palakkad town being arranged. There is no fee, compulsory attendance or examinations. Wherever possible, study material is provided.



The what and how of the Palakkad Math Circle

Thirty to forty high school students meet with a mentor for a couple of hours in an informal setting on weekends to work on interesting problems or topics in mathematics. Besides cultivating awareness and appreciation of the beauty and power of mathematical ideas in understanding the world, the goal is also to dispel anxiety and fear of mathematics among school students.

Salient Features

- ◆ **Not chalk and talk.** The fundamental goal of the math circle session is to engage youngsters through creative means such as a game, an activity, or a real-world problem. The emphasis is on active and interactive learning.
- ◆ **No set syllabus.** The objective is not to cover material but to select topics that have the potential to make for an engaging session.
- ◆ **Teacher involvement.** School teachers are encouraged to participate in the sessions to catalyze a domino effect and amplify outreach in their networks, beyond the selected students.
- ◆ **Voluntary.** Participation is voluntary but commitment is expected.
- ◆ **Accelerated learning.** Sessions led by professional mathematicians who present the content at a deep level. This helps accelerate the students' learning beyond their grade and also ensures that some of the occasional profound questions raised by the students get the attention they demand.



Above and beyond Regular Math Circle Sessions

Apart from the regular sessions, a few other activities conducted by the Palakkad Math Circle team so far, include:

One-Day Attachment Programme at C-SiS

10 Feb 2024

The Centre for Science in Society (C-SiS) is a center for the popularization of science and technology located on the Cochin University of Science and Technology (CUSAT) campus. The Centre aims to create scientific awareness among students through play models, in addition to facilities like a library, science labs, math lab, and science parks, where students can “see” the theories that they have encountered in the textbooks come alive. The Centre has a One-Day Attachment Programme (ODAP) where these facilities can be reserved for a day by students and their teachers who can then spend the day at the Centre interacting with the models and exhibits, and engaging in various activities. The Palakkad Math Circle students were taken to spend a day at CSiS by Math/CSE faculty from IIT Palakkad. Students visited the facilities and participated in several experiments and activities during this day-long program. This, the Palakkad Math Circle team believes, gave them a different perspective on science and enabled them to see the application of scientific principles. Alongside the hope that the experience helped students understand and appreciate school science better, the team felt benefited with some thoughts for a future Science & Technology Center and Museum expected to take shape at IIT Palakkad.



Teachers Workshop - Making Connections in Mathematics

27 Feb 2024

The Palakkad Math Circle team also organized a workshop for teachers with the objective of enabling teachers to make connections across various content areas of mathematics and apparently disparate mathematical ideas, and to be apprised of the mathematics underlying everyday activities, including art. The workshop sessions were chosen in such a way as to support teachers to make these connections.



The workshop had 3 Sessions

- ◆ On connecting the history of mathematics to pedagogical moves to clarify an important concept from the secondary school mathematics textbook and to understand common errors that students make in the light of the historical development of this idea.
- ◆ On multiple representations and the connections between them with focus on visual representations of an abstract idea from the higher secondary school syllabus.
- ◆ A demonstration of elements of mathematics present in music, also encountered in secondary/senior secondary mathematics textbooks.

The workshop was attended by 42 teachers from schools in Palakkad and 2 Block Resource personnel. The sessions were anchored by external experts invited for the purpose. The music and mathematics session brought together a team of musicians and a mathematics expert.

Panel Discussion on Building Partnerships in Science

18 Mar 2024

With a view to understand how IIT Palakkad as an Institute could build better partnerships with agencies that work in school education (SCERT, SSK) and contribute to society, the Palakkad Math Circle team also organized a panel discussion on the topic “Building Partnerships in Science” with invited experts Dr. Jahnvi Phalke, Dr. N. Shaji, Sh. C Riswan, Dr. B Shaji, and Dr. P Shaiju. As the founding director of Science Gallery, Bengaluru, Dr. Jahnvi Phalke offered her experience of enabling a proactive public engagement in science, through designing research festivals, interdisciplinary exhibitions, and other public events bringing together the sciences, engineering, art, and culture.

Dr. N. Shaji and Sh. C Riswan contributed rich experience of science popularization at the grassroots level through their pioneering roles in the Kerala Sastra Sahitya Parishad (KSSP) and as editors of popular science magazines. Dr. B Shaji and Dr. P Shaiju have hands-on involvement in the programmes of Samagra Shishsha Keralam (SSK) that span Kerala state. Prof. Seshadri Sekhar (Director, IIT Palakkad) also participated in the discussion. Drawing inspiration and ideas from these luminaries, some potential areas were identified where the Palakkad Math Circle can contribute to partner agencies already working in these directions. The first among these - a month-long puzzle series with LUCA - was launched on May 1, 2024.



STUDENT'S ALCOVE

Y- DYUTHI: IGNITING THE CURIOSITY IN YOU



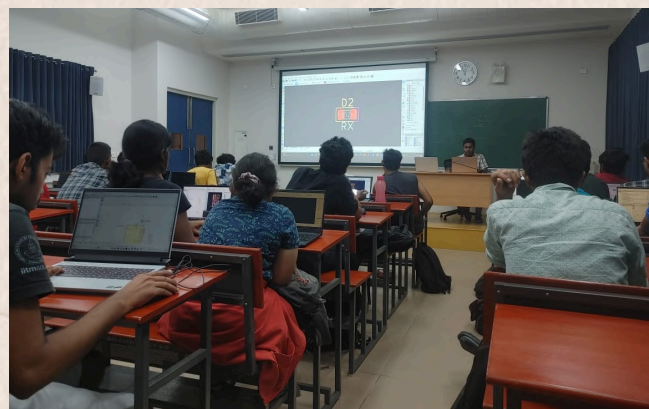
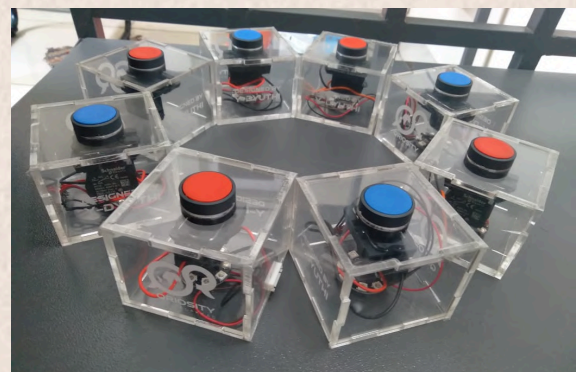
Y - dyuthi is the official electrical club of IIT Palakkad.It is a forum where students engage their curiosity related to all things to do with circuits - be it analog or digital. The members of the club get together to have discussions about a variety of projects and workshops.



WORKSHOPS CONDUCTED

- ◆ Understanding the use of DSO
- ◆ State space modeling - An introduction to control systems
- ◆ Introduction to designing - PCBs using KiCAD
- ◆ Modeling of DC-DC Buck Converter using Matlab

These workshops can be attended by all students as they start from the very basics to help strengthen core concepts which help cultivate an interest towards the field. The club has seen an increase of participants in these events, thus successfully achieving its main objective which was to encourage and foster a passion towards the field of Electrical Engineering. This has been made possible with help of the active student community, dedicated core team and the support of faculty members. There are many ongoing projects which were pitched by the club members. Y-dyuthi is not only about electrical engineering but also motivates exploration of interdisciplinary activities. For instance, the club partnered with the quiz club 'Qriosity' to design and create quiz buzzers to be used during competitions. During Petrichor, Y-dyuthi conducted a PCB designing competition 'Chipcraft' which witnessed enthused participation.





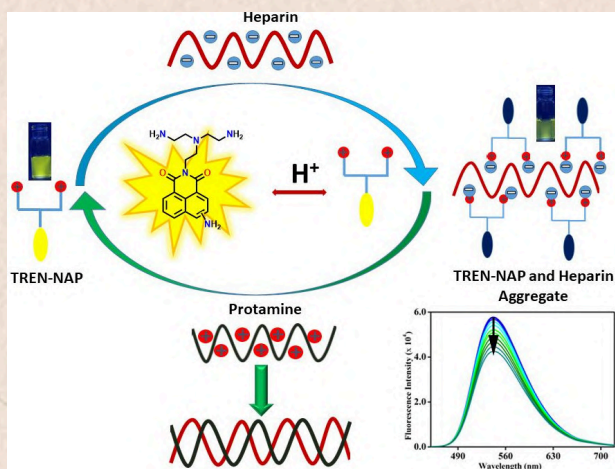
SENSING ANTICOAGULANT DRUG 'HEPARIN'

Heparin is a well-known anticoagulant drug used to prevent blood clotting during a number of procedures like open-heart surgery, bypass surgery, kidney dialysis, and blood transfusion. Heparin plays an indispensable role in various biological processes including inflammation and cell growth. During a surgery, the doses of heparin that are administered must be regulated within the permissible limit, as an overdose can lead to adverse effects. This necessitates a suitable and feasible detection method for selective detection and close monitoring of the concentrations of heparin. However, developing a practically useful detection method is difficult because of the interference due to other competing analytes in the biological mediums. The existing method to measure the heparin level in blood is based on clotting time, which is not a safe method. Dr. Shanmugaraju's research team at the Department of Chemistry, IIT Palakkad recently developed a practically useful detection method based on fluorescence-based sensing for the trace monitoring of the concentration of heparin. This fluorescence-based detection method is more sensitive, economical and faster than existing detection methods.



Mannanthara Kunhumon Noushija &
Sankarasekaran Shanmugaraju

The team synthesized two small-molecule fluorescent dyes, namely TREN-NAP (see the structure of sensors attached), based on green emitting amino-1,8-naphthalimide fluorophores. TREN-NAP senses heparin through specific electrostatic interactions between the positively charged TREN-NAP and negatively charged heparin polyanions, which result in fluorescence attenuation due to molecular aggregations (see the schematic representation of the sensing mechanism). Selective sensing can easily be visualized through sharp visual color changes. They have demonstrated that by measuring the changes in the fluorescence intensity of TREN-NAP, the heparin level can be measured in the blood. TREN-NAP selectively binds with heparin even in the presence of other competing biomolecules that belong to the heparin family. Moreover, the TREN-NAP has shown excellent working capability in human serum, which further strengthens the future perspective of the innovation. They also tested the reusability sensors and found that the heparin sensing ability of TREN-NAP can be reversed. In a nutshell, this new detection method is useful and can be practically applied to measure doses of heparin to positively impact the well-being of people.





ELECTRIC DISCHARGE ASSISTED POST-PROCESSING OF METAL ADDITIVE MANUFACTURED SURFACES FOR ENHANCED PART QUALITY

Afzaal Ahmed & Jibin Boban

Metal additive manufacturing (AM) is gaining significant attention in the modern industrial world due to the design freedom offered by the technology. Unlike conventional fabrication methods, parts/components with high degree of complexity can be successfully realized using metal AM. Moreover, the technology offers exceptional benefits such as mass customization, minimal scrap formation and suitability for batch production. However, the parts/components fabricated using metal AM always exhibit poor surface integrity and lack of geometrical form accuracy. Therefore, post-processing of metal AM parts/components is inevitable for enhancing the acceptability of these components at application level in industries. The existing post-processing variants comprise laser polishing, chemical finishing, abrasive polishing, mechanical surface treatments and hybrid polishing methods. Nevertheless, many inherent limitations are associated with each of the aforementioned processes. Therefore, a low energy electric discharge assisted post-processing method is proposed as an end solution to overcome such limitations associated with metal AM parts/components.



Afzaal Ahmed



Jibin Boban

The study encompasses a detailed investigation on the feasibility of a wire electrical discharge polishing (WEDP) method (*Fig. 1*) in overcoming the limitations of metal AM parts/components. The proposed technology is capable of effectively eliminating surface irregularities, thereby contributing sub-micron surface finish. In WEDP, the continuous low-energy electric spark generated between the moving wire electrode and metal AM surface removes a thin, rough surface layer with a thickness equivalent to the S_z value (the maximum height of the roughness profile).

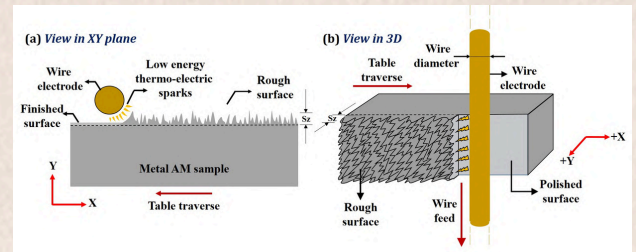


Fig.1 Schematic of WEDP process

The traces of wire material deposition on polished surfaces were found to be minimal due to the minimal spark energy generated in the inter-electrode gap during the WEDP process. Thus, the composition of bulk specimens remains nearly unaltered after WEDP operation. In addition, the results of the study showed that the process can improve mechanical properties such as surface hardness and tribological performance.

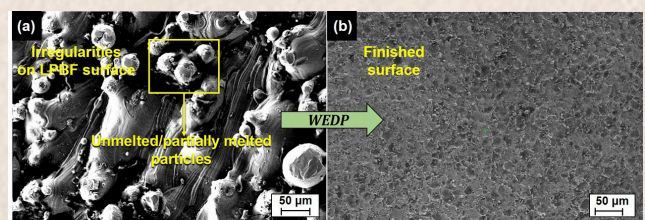


Fig. 2 Surface morphology of (a) as-built LPBF and (b) WEDP processed samples

It is noteworthy that the method exhibits immense potential to process metal AM alloys, irrespective of their physical properties and alloy composition. WEDP guarantees outstanding surface characteristics on additively manufactured high-strength-to-weight ratio aerospace alloys such as AlSi10Mg and Ti6Al4V regardless of their contrasting thermal properties (a large difference between alloys in terms of melting point and thermal conductivity). The surface finish achieved by the metal AM alloys can easily approach the sub-micron range with a minimal pulse on time (*Fig. 3(a)*) and despite its improvement in surface finish (*Fig. 3(b)*), the method does not deteriorate the exceptional corrosion performance offered by the alloys.

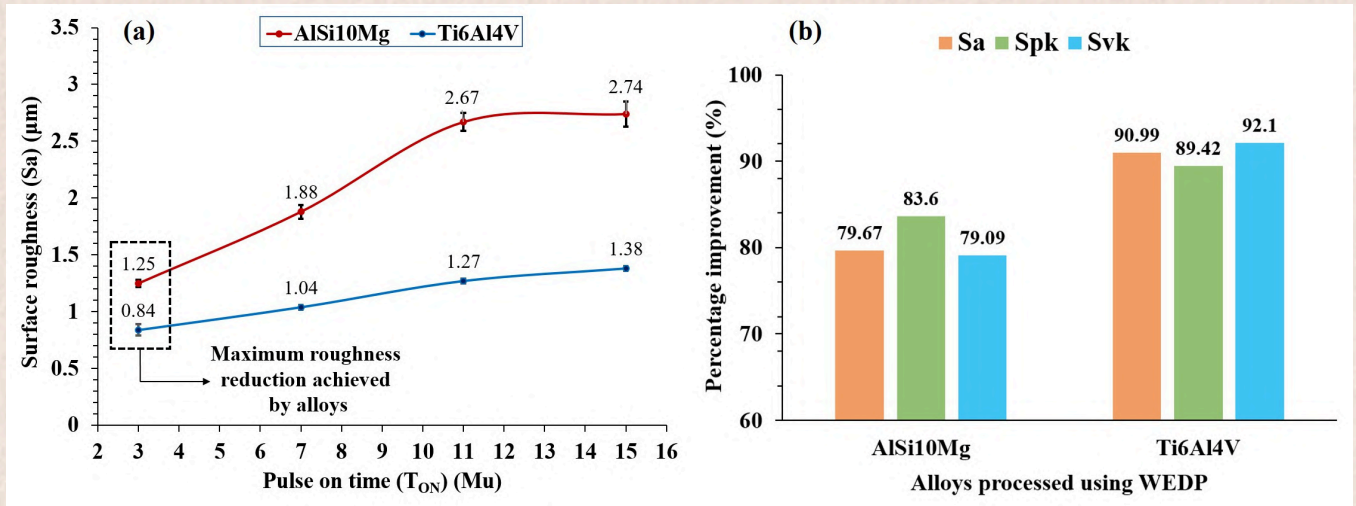


Fig. 3 Surface finish enhancement on AlSi10Mg and Ti6Al4V alloys through WEDP process

The form deviations in non-planar metal AM parts in terms of flatness, circularity and cylindricity errors were found to decrease after the proposed process irrespective of the geometry. The flatness error in inclined specimens, regardless of the build angle and orientation, was largely minimized to ~7 μm after the WEDP process. WEDP also aided in transforming the undesirable geometric deviations observed in LPBF inclined specimens into sharp edges as shown in Fig.4 Moreover, the elimination of stair-stepping effect and other irregularities enhanced the circularity and cylindricity of the curved LPBF samples.

Furthermore, the low energy electric discharge method can be extended to process internal features built using metal AM as well.

In a nutshell, the proposed low energy electric discharge assisted polishing method is a promising approach capable of enhancing the surface integrity and geometrical form accuracy of planar, non-planar and internal surfaces irrespective of material properties thereby favouring the large-scale usage of metal AM parts/components in industries.

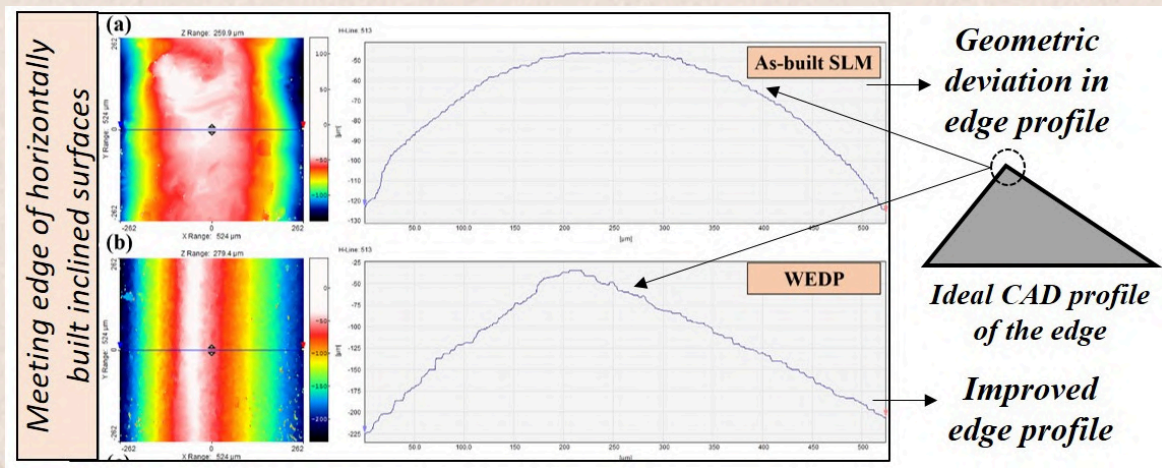


Fig. 4 Geometric profile of (a) as-built LPBF and (b) WEDP processed samples





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