



# E-NEWSLETTER

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## Edited by:

Dr. Chaitanya Lekshmi  
Life Member, ECSI

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Indian Institute of Science Campus  
Bengaluru - 560 012,  
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## Message from the President, ECSI



I am happy to see that the Second issue of the E-Newsletter of the ECSI is now ready for release with relevant information and details of interest and benefit to the member community. Though it has been delayed a lot the issue has been well conceived with details of all major events conducted since the release of the first E-Newsletter in July 2019. During this period we had started ECSI activities at Chandigarh along with a Workshop on “Electrochemical Techniques: Energy, Sensor and Corrosion Applications (WET2019)” in November 2019, and conducted a Two Day National Conference on “Advanced Lithium Ion Batteries: Science and Technology (NALiBST)” during December 2019 at IISc. Campus, Bangalore. The pandemic situation created just

after the spread of novel Corona virus has not put our committee in difficulties as I have seen a number of online digital events systematically organised during the last 9 months. Some of the weekly webinars organised under “Materials and Electrochemical Science and Technology” by General Secretary Dr H.P. Nagaswarupa and Joint Secretary, Dr. Dinesh Rangappa, and other online events have attracted huge attendance from the scientific community. We had a One day online Workshop on “Surface Engineering and Modification for Better Performance” with international and national speakers during September 2019. This E-Newsletter is not covering some of the events like the Special Panel Discussion we had on August 15, 2020 along with eminent professionals and I am sure the next issue will have an article on the same. It is fortunate that the newsletter is released during the Online Two Day National Symposium on Electrochemical Science and Technology (NSEST 2020) and ECSI Research Scholars Meet (ECSIRM 2020) during January 21-22, 2021. I request all members to go through the same and get acquainted with the developments in ECSI since July 2019. I am also taking this

opportunity to request all the members to contribute a summary of the events as well as articles of relevance to the newsletter. It is my privilege to be the President of ECSI and I am sure with all your cooperation and support we can do many wonderful events of high significance to the industry, academia, and society. Thanks to our member Dr. Chaitanya Lekshmi for editing this issue of E-Newsletter, and we look forward to future issues with interesting and useful information to the benefit of member community of ECSI and our patrons in industry, academia and R&D institutions.

**U. Kamachi Mudali**  
President, ECSI, 2019-120

 **THE ELECTROCHEMICAL SOCIETY OF INDIA**   
Indian Institute of Science Campus, Bengaluru – 560 012  
and  
**DEPARTMENT OF INORGANIC & PHYSICAL CHEMISTRY**  
Indian Institute of Science, Bengaluru-560 012

*Cordially invite you for the*  
**INAUGURATION**  
of  
**National Symposium on**  
**ELECTROCHEMICAL SCIENCE AND TECHNOLOGY**  
**[NSEST-2020] &**  
**ECSI RESEARCH SCHOLARS MEET 2020 [ECSIRM-2020]**  
&

**ECSI Awards Function**  
(Life Time Achievement Award, S.K. Seshadri Memorial  
Mascot National Award, N.M. Sampat Award)

by  
Chief Guest  
**Prof. Sharanappa V. Halse**  
Vice Chancellor  
Davangere University, Shivangotri, Davangere

**Dr. E. Arunan**  
Professor & Chair  
Dept. of Inorganic and Physical Chemistry, IISc., Bengaluru  
will be the Guest of Honour

**Dr. U. Kamachi Mudali**  
President, ECSI, will preside over

Via Cisco Webex Online  
at 09.30 a.m. on Thursday, 21<sup>st</sup> January, 2021

**Dr. Nagaswarupa H.P**  
Gen. Secretary. ECSI

*All are Welcome!*

 **THE ELECTROCHEMICAL SOCIETY OF INDIA**   
Indian Institute of Science Campus, Bengaluru – 560 012  
and  
**DEPARTMENT OF INORGANIC & PHYSICAL CHEMISTRY**  
Indian Institute of Science, Bengaluru-560 012

*Cordially invite you for*  
**31<sup>st</sup> Prof. T.L.Rama Char Memorial Lecture**

by  
**Dr. G.D. Yadav**  
Former Vice Chancellor & Emeritus Professor of Eminence  
Institute of Chemical Technology, Mumbai

on  
**The Hydrogen Economy:**  
**Climate Change and Sustainable Development**

at 2.00 - 3.30 PM, Thursday, 21<sup>st</sup> January, 2021  
via Cisco Webex Online

**Dr. S. Sampath**  
Professor & Vice President, ECSI  
Department of Inorganic & Physical Chemistry  
Indian Institute of Science, Bengaluru, will preside over

*The Memorial Lecture is Co-sponsored by*

 **NACE** GATEWAY INDIA  
INTERNATIONAL SECTION

**The Malleswaram Co-Operative Bank Ltd.**  
Bengaluru- 560 003

**Dr. Nagaswarupa H.P**  
Gen. Secretary. ECSI

*All are Welcome!*



## Governing Council of ECSI 2019-2020

Dr. U. Kamachi Mudali	President
Prof. E. S. Dwarakadasa	Immediate Past President
Dr. P. Parthasarathy	Vice-President
Prof. S. Sampath	Vice-President
Prof. M.A. Pujar	Vice-President
Mr. Rajeeva Deekshit	Vice-President
Dr. Nagaswarupa H.P	General Secretary
Dr. Dinesh Rangappa	Joint Secretary
Mr. C. Antonisamy	Treasurer

### Members

Dr. M. A. R. Iyengar	Mr. V. K. William Grips
Dr. Shaheen Taj	Dr. J. N. Balarajau
Dr. M. Nethaji	Mr. P. G. Chandramani
Dr. Alka Sharma	Sri. R. Moorthy
Dr. M.S.Santhosh	Mr. Sundeep Seshadri

### Co-opted Members

Dr. Harish C. Barshilia	Dr. Vivekananda Kain
Dr. V. S. Raja	Mr. Rajendra Alevoor
Dr. Rani P. George	Dr. Chaitanya Lekshmi Indira
Dr. H. K. T. Kumar	Dr. S. T. Aruna
Prof. K. A. Bulbule	Dr. Prathibha
Dr. H. Vishwanath	

### Former-Presidents and General Secretaries

Dr. R. P. Dambal	Former- President
Shri. M. Ravindranath	Former- President
Dr. A. K. Sharma	Former- President
Dr. H. B. Rudresh	Former- President
Dr. J. R. Mudakavi	Former- General Secretary
Mr. Rajeeva Deekshit	Former- General Secretary

## About us....



The Electrochemical Society of India, popularly referred to as ECSI, celebrated recently its Golden Jubilee year. The Society was conceived and started by Professor T. L. Rama Char, who at that time was a Professor in the Inorganic and Physical Chemistry Department of the Indian Institute of Science, Bengaluru. Based on his contacts with the Electrochemical Society, USA, he started an India Section of the Electrochemical Society of USA in 1954 with himself as the Founder President and several of his own students as office bearers.

Simultaneously, he started publishing a News Letter in the form of a Journal which contained articles on developments in Electroplating. Several members felt that the progress in Electrochemistry in India was large enough to sustain an independent organization, a Scientific Society under the name of “Electrochemical Society of India” with the acronym ECSI was registered in the year 1964 and the News Letter was christened “Journal of the Electrochemical Society of India”. The past Presidents include: Professor T. L. Rama Char, Prof. S. Kappanna, Sri. J. Balachandra, Prof. K. I. Vasu, Dr. S. Krishnamurthy, Dr. R. P. Dambal, Mr. Kangovi, Dr. S. K. Sheshadri, Dr. Indira Rajagopal, Dr. S. R. Rajagopalan, Prof. S. M. Mayanna, Dr. Bala Gangadhar, Prof. Padma, Prof. B. S. Sheshadri, Prof. E. S. Dwarakadasa, Dr. H. B. Rudresh. The Society has grown in stature and size due to the tireless efforts of all the stalwarts steering the Society from time to time. There have been very able Secretaries who have managed the affairs of the Society to bring it to its present position of fame in the country. Currently the President of ECSI is Dr. U. Kamachi Mudali, Chief Executive & Chairman, Heavy Water Board, DAE, Mumbai.

Sometime early in the nineties, the Governing Council decided to encourage Teachers and Students to interact with scientists. This was facilitated by providing a special platform for them in the Annual Conference of the Society usually held in the month of July every year titled National Seminar on Electrochemical Science and Technology, NSEST for short. Publication of the News Letter of the Society was utilized by Book Publishers such as McGraw Hill, to ask the Editor to publish Book Reviews. Copies of books sent for reviews were collected together and a Library was started, which today has very valuable books in the area of Electrochemistry. There are about 3000 books. Members of the Society are eligible to borrow books. There is a plan presently to get all the books digitized and make them available for Members. This will become operational once the Copyright questions are answered.

As the Society grew, Membership was opened to anyone interested in the various areas of Electrochemistry. However, possessing a bachelor's degree was required to become a member. Many industrial organizations evinced interest in joining and supporting the Society and a category of sustaining Membership was started. Details of Membership may be seen in the URL: [www.ecsi.in](http://www.ecsi.in).

Over the years of growth, a number of programmes of interest to the electrochemists and related fields have been made a common feature in the yearly activities of the Society. This includes the following: Prof. T. L. Rama Char Memorial Lecture, Prof. B S Seshadri Memorial Lecture, Dr. S. Krishnamurthy Memorial Lecture, Prof. S. Mayanna Endowment Lecture. Due to generous support, the Society gives away the S. K. Sheshadri Memorial Mascot Award supported by the Mascot Group of Companies and the N. M. Sampath Award instituted by the Canning Mitra Phoenix group of Companies every year to persons who have contributed to the Industry and Society in the fields of Corrosion and Metal Finishing, respectively. In addition to this every year the best papers published in the fields of Corrosion and Metal Finishing also receive the Best paper Awards. A very significant feature of the activities of the Society is the publication of the Journal of the Electrochemical Society of India (JECESI). Presently it is running volume 68 meaning it has been published continuously for more than 60 years.



## On NSEST 2019



The National Symposium on Electrochemical Science and Technology (NSEST 2019) was jointly organised by The Electrochemical Society of India and the Department of Inorganic & Physical Chemistry (IPC), Indian Institute of Science (IISc), Bengaluru during 19-20 July, 2019 at The Choksi Hall in IISc campus. This annual conference is one of the flagship programmes of the society providing special platform for teachers and students to interact with eminent scientists working in electrochemical science and technology in India and abroad. ECSI organises series of symposia under this title in July every year, recognising the importance of outreach to college and university teachers and researchers. Inaugural programme of NSEST 2019 started with welcome address by General Secretary Dr. Nagaswarupa H. P. followed by lighting the lamp and Presidential address by Dr. U. Kamachi Mudali, Distinguished Scientist, DAE and Chairman and Chief Executive of Heavy Water Board, Mumbai. The inaugural address was delivered by the Chief Guest of the symposium Dr. Sanjeev S. Katti, Director General, ONGC Energy Centre, New Delhi, who also delivered 30th Prof. T. L. Ramachar lecture later on the same day. Dr. Katti highlighted the relevance of electrochemical techniques and methods in the energy and gas sector of the country and briefed on the major activities of his research centre contributing to the growth of the country. He also briefed on the different collaborative ventures and funding programmes initiated by

centre to different academic institutes in India. Prof. E. S. Dwarakadasa, Emeritus Professor, Department of Metallurgy, IISc, ex-President of ECSI and Chairman, Karnataka Hybrid Micro Devices Limited, Bengaluru presided over the inaugural function. The Guest of Honour address for the event was given by Dr. N. Munichandraiah, Emeritus Professor, Dept. of Inorganic and Physical Chemistry, at IISc, Bengaluru. An award ceremony was conducted after this to felicitate awardees of various ECSI awards.



**Inaugural Function (Prof. E.S.Dwarakadasa, Dr. Nagaswarupa, Dr. U. Kamachi Mudali, Dr. Sanjeev Katti, Prof. N. Munichandraiah and Rajeeva Deekshit)**

There were several technical sessions during the symposium, which started on 19th July with S. K. Sheshadri Memorial Mascot National Award lecture delivered by Dr. S. Ramanathan from IIT Madras. Keynote lectures of the day were delivered by Dr. Damaraju Parvatalu from OEC, NewDelhi and Dr. A. Senthilkumar, VIT University respectively. Several technical papers were presented by enthusiastic researchers, teachers, postgraduate and undergraduate students from across the country on wide ranging topics as Environmental electrochemistry, New materials in electrochemical systems, Electrosynthesis and Metallurgy, Industrial electrochemical processes, Electroanalysis and power systems, Corrosion science and materials protection particularly related to aerospace and industry applications, Hydrogen: electrochemical production, storage and applications, Nanoscale electrochemistry, Bioelectrochemistry, electroplating and surface engineering, Electrochemical Sensors & Devices, Batteries, E-waste environmental issues.



**Presentation of ECSI awards and group photo taken during the Inaugural Function**

The symposia saw two N. M. Sampat Awards Lectures being delivered on the second day of the programme by Dr. S. K. Ghosh, Bhabha Atomic Research Centre, Mumbai and Mr. Rajendra Alevoor from Indian Space Research Organisation, Bengaluru. The 11th Prof. S. Krishnamurthy Lecture was delivered during the event by Dr. S. Rangarajan from BARC Facilities. The 16th Prof. S. M. Mayanna Endowment Lecture was given by Dr. M. Pandurangappa from Bangalore University. The enthusiastic participation from research and student community during the two day event made the technical sessions memorable.



**ECSI general body meeting held on 19th July being presided by Dr. Kamachi Mudali, Prof. E. S. Dwarakadasa and attended by the other members of the society.**

A general body meeting of ECSI was conducted at the end of the first day presided over by the President Dr. Kamachi Mudali of the society, and attended by Prof. E.S. Dwarakadasa (ex-President), General Secretary Dr. Nagaswarupa and other members and co-opted members and discussed the targets for the coming year, attainment of funds and memberships, besides important activities to be taken up. The concluding session of NSEST 2019 was conducted on the last day evening. Vote of thanks was delivered by the General Secretary Dr. Nagaswarupa H. P. Symposium saw a total of 18 invited lectures and 50 oral presentations and was well represented from academic and research institutes, government laboratories, university colleges and industry R&D from across the country.

As in most ECSI technical events, the sponsors from associated industries and national funding agencies have supported this activity.

Dr. Chaitanya Lekshmi Indira  
CMR Institute of Technology  
Bengaluru



## Prof. B. S. Sheshadri Memorial Lectures



**THE ELECTROCHEMICAL SOCIETY OF INDIA**  
**Indian Institute of Science Campus, Bengaluru-560 012**  
&  
**Dept. of Chemistry, Central College, Bengaluru University, Bengaluru**  
**Cordially invites you for the 17<sup>th</sup>**  
**Prof. B.S. Sheshadri Memorial Lecture**

ECSI holds Prof. B. S. Sheshadri Memorial lectures every year in the month of September. The 18th Prof. B. S. Sheshadri Memorial lecture was held online on 5th September 2020 under the aegis of the Department of Chemistry, Central College, Bengaluru University. Dr. Rajendra Alevoor, Scientist Indian Space Research Organisation and a lifetime member of the Electrochemical Society of India gave an informative lecture on Multifunctional Surface Engineered Material by Electrochemical Techniques, where he dwelled on the growth drivers and applications in this area of R&D, especially with respect to aerospace and space research. The session was chaired by President of ECSI, Dr. Kamachi Mudali, while the welcome address and the introduction to speaker were given by Dr. Nagaswaroopu, ECSI General Secretary and Dr. Prasanna Shivaram from Central College, Bengaluru. Dr. Nandeesh L. also from Central College gave the customary introduction to his own teacher Prof. B. S. Sheshadri, one of the finest electrochemists of India to the new attendees. The session was concluded by our young ECSI member Dr. Prathibha Singh. Earlier, the **17th Prof. B. S. Sheshadri Memorial lecture was held** at the Department of Chemistry, Central College, Bengaluru University, Bengaluru, on 6th September, 2019. The award lecture was delivered by **Dr B. R. Balagangadhar**, Chief Scientific Officer, Karnataka State Pollution Control Board, Central Laboratory, Nisarga Bhavan, Shivanagara, Bengaluru on “**Ecological Imbalances –Causes and Solution**”. The session was chaired by **Prof. Pandurangappa M.** of Department of Chemistry, Bengaluru University, Central College City Campus, and Prof. E. S. Dwarakadasa, ex-Chairman of ECSI presided. Dr. Nagaswarupa, General Secretary of the society, Dr. Dinesh Rangappa, Joint Secretary, Dr. Rajeeva Deekshit, Dr. H. B. Rudresh, Dr. Shaheen Taj, Dr. M. S. Santhosh and Dr. Chaitanya Lekshmi Indira, members of the society were also present during the occasion.

## **Inauguration of ECSI Chandigarh Chapter & Workshop on Electrochemical Techniques: Energy, Sensor and Corrosion Applications- WET 2019**

ECSI Chandigarh Chapter was inaugurated in “Workshop on Electrochemical Techniques: Energy, Sensor and Corrosion Applications”, WET-2019 organized by Central Scientific Instruments Organisation (CSIO), Chandigarh during November 18-19, 2019 under CSIR-Integrated Skill Initiative program. Electrochemistry has an ever increasing impact in everybody’s daily life. Electrochemical energy conversion and storage are directly at work in consumer batteries (like in notebooks, smart phones and car batteries) increasingly, and in fuel cells. Many physiological processes in our body depend on electrified interfaces and electrochemical processes. CSIR-Central Scientific Instruments Organisation is well known for its research activities in the domain of sensors, energy and corrosion be it healthcare, environment, water quality, energy harvesting, hydrogen fuel and in-house developed biomedical implant corrosion study. These domains have touched every aspects of societal as well as industrial sector. Chandigarh region is an education hub and is surrounded by institutions of higher learning and research in tri-city area comprising Chandigarh, Mohali and Panchkula of Punjab and Haryana states. A large number of premier education and industrial institutions are lying under this region like IISERs, IITs, INST, NIPER, PU, TBRL, CSIR, etc. The objective of proposed local chapter was to foster research, innovation, and development in the area of electrochemistry, and achieving excellence in this field via bringing researchers, students, and industries. It will help to boost these activities and work in more close association with academicians of like-minded interest as well as get close inputs of industries to deliver solutions for them.

The two-day workshop aimed to familiarize young researchers/students to the advances of theoretical and experimental electrochemical technologies. The program included 06 academic and 02 industry talks, and hands on session on 08 electrochemistry modules. Around 52 participants across the distinguished universities and institutes like IIT Bombay, IIT Mandi, IIT Roorkee, NIT-Raipur, Manipal University-Jaipur, Bundelkhand University-Jhansi, CCS HAU-Hisar, CSIR-NEIST-Assam, I.K.G. Punjab Technical University- Jalandhar, INST-Mohali, Panjab University-Chandigarh, GGSDS College-Chandigarh and IISER Mohali attended this workshop. The experts’ speakers from IIT Ropar, IIT Mandi, IISER, INST, and ECSI shared their knowledge as well as research findings in these fields.



**(Left) Prof. R.K. Sinha, Director CSIR-CSIO welcoming Professor E.S. Dwarkadasa during the Inaugural Function of WET-2019; (Right) Inaugural Lamp Ceremony of WET 2019 by Director CSIO.**

The main theme of the workshop was on electrochemistry, the talks of the speakers were focused on the basics and recent advancements in this field. The hands on module were focused upon the basics of electrochemistry and photoelectrocatalysis, electrochemistry for biosensors, supercapacitors, solar cells, corrosion studies, chemical sensors and energy storage devices. The hands on training sessions allowed the participants to get a flavour of various applications of electrochemistry. The participants were involved in the sessions with great enthusiasm.



**Prominent speakers of the workshop and glimpses of few hands-on-training**

Many participants who were already aware of the aspects of the electrochemistry used this platform to clear their doubts that they were facing in the research back at home lab. The morning sessions of this workshop was reserved for the plenary lectures by the distinguished speakers whereas, the afternoon sessions had the hands on trainings. From the feedback that we got from the speakers as well as the participants, they were quite happy with this event and found this highly useful and many look forward to take part in future events like this.

### **Topics of Invited Lectures and Speakers:**

- Nanotechnology in Electrochemistry by Prof. Dwarakadasa, CEO and MD, Karnataka Hybrid Micro devices, and Past President Electrochemical Society of India
- Potential of Nanomaterials for Chemosensor Development & Water Purification by Dr. Narinder Singh, IIT Ropar
- Linking microbiology with electrochemistry: basics and applications by Dr. Sunil Patil, IISER Mohali.
- Defects Modulation in Transition Metal Oxide and Sulphide for Electrochemical Hydrogen Production, by Dr. Aditi Halder, Assistant Professor, IIT Mandi.
- Electrochemical Systems for Energy Research & Education, by Dr. Ritesh Vyas, Industry Representative, Metrohm Autolab
- Enhanced Catechol Biosensing on Metal Oxide Nanocrystal Sensitized Graphite Nanoelectrodes through Preferential Molecular Adsorption by Dr. Chaitanya Lekshmi Indira Head of CoEs: Materials Science/ Sensors & Nanoelectronics and Associate Professor, Chemistry, CMR Institute of Technology
- In-situ synthesized mesoporous Mo<sub>2</sub>C/MoO<sub>2</sub> nanocomposite showing enhanced HER activity by Dr. Vivek Bagchi, Scientist, INST Mohali
- Electrochemical biosensor for the detection of A $\beta$  peptide in Patients with Alzheimer's Disease using dried blood spot matrix by Dr M.S. Santosh, Center for Incubation, Innovation, Research and Consultancy (CIIRC), Bangalore
- How to get best results for Electrochemistry Measurements, Dr. Varghese Samuel, Biologic Instruments, India



### **Lab Visit and demonstration on Chemical Sensors, corrosion, water & energy, photo electrochemistry and biosensors**

#### **Details of hands on training - areas and instruments handled.**

- Electrochemistry Fundamentals
- Photo-electrochemistry
- Solar Cells Characterization
- Battery Characterization
- Corrosion Study of Implants
- Biosensor Characterization
- Supercapacitor Characterization
- Electrochemical Sensor for Inorganic Pollutants

Sumptuous breakfast, lunch and dinner were arranged for all outstation participants which was also one of the major attraction of the stay at Chandigarh. The event was successfully organized and narrated here by Dr. Pooja Devi, Sr. Scientist at CSIR-CSIO with the constructive support and co-operation of Director CSIO, senior scientists, technical staff and research scholars of the organization.



She is the recipient of many prominent awards which include Young Associate, Indian Academy of Science (IASc), Bangalore and SERB Women Excellence Awardee (Engineering Science, 2020) . Dr. Pooja Devi is also Member, Indian National Young Academy of Sciences (INAYAS), INSA, New Delhi.



## Technology Webinar

On Monday 28<sup>th</sup> December, 2020

Google meet link: <https://meet.google.com/hcd-nkpy-uhq?hs=224>

### Chemosensors and Devices for water pollutants monitoring

Time: 2.15 pm

Speaker: Dr. Pooja Sharma

Sr. Scientist

CSIR-Central Scientific Instruments Organisation



Dr. Pooja has done her PhD in Engineering from Academy of Scientific and Innovative Research (AcSIR), New Delhi (2018). Currently, she is leading a research group under "WSL-Water Science Laboratory", Agrionics Division, CSIR-Central Scientific Instruments Organisation, Chandigarh. She is recipient of several prestigious awards and fellowships, few being INAE Young Engineer ward (2020) from Indian National Academy of Engineering; SERB Women Excellence Award (2020); and Associateship of Indian Academy of Science (2019-22). She has several publications in peer reviewed international journals to his credit

### Vibration energy harvesting for pollution remediation using piezoelectric materials

Time: 3.15 pm

Speaker: Dr. Rahul Vaish

Associate Professor, School of Engineering, IIT Mandi



Dr. Rahul has done his PhD in Engineering from Indian Institute of Science Bengaluru (2010). Currently, he is Associate Professor at the School of Engineering, IIT-Mandi. His research expertise is in the domain of materials selection, Glasses for Electrical Application, Pyroelectric and Piezoelectric Energy Harvesting Materials and Methods. Dr. Rahul is recipient of multiple prestigious awards and fellowships such as Dr. R.L. Thakur Memorial Award (2013), INSA Medal for Young Scientists (2013), IEI Young Engineers Award 2012-2013, INSPIRE Faculty Award-2011. He has several publications in peer reviewed international journals to his credit

#### PROGRAM COORDINATORS

Dr. Chaitanya Lekshmi Indira (Head)

Dr. Tukaram Shet (Member)

#### CMR Institute of Technology

(NAAC A+ Accredited)

132 AECS Layout, IT Park Road  
Kundalahalli, Bengaluru 560037

#### Organized by:

CoEs: Materials Science/ Sensors & Nanoelectronics

<https://sites.google.com/cmrit.ac.in/coematerialsscience/home>

<https://sites.google.com/cmrit.ac.in/coesensorsnanoelectronics/home>

Above are the details of technology webinar organized at CMR Institute of Technology, Bengaluru on 28th December, 2020. Dr. Pooja along with Dr. Rahul Vaish from IIT Mandi were the expert speakers. Prof. Dwarakadasa presided the event and Dr. Chaitanya Lekshmi, Head CoE: Materials Science/ Sensors & Nanoelectronics at CMRIT and Dr. Tukaram, member CoE were the hosts.

## Two – Day National Conference on Advanced Lithium Ion Batteries: Science and Technology, (NALiBST-2019)

The National Conference was organised on 27-28<sup>th</sup> December 2019 by ECSI jointly with the Department of Inorganic and Physical Chemistry at IISc. The initiative was taken by Dr. Nagaswarupa and Dr. Dinesh Rangappa of the society and Inaugural function was presided by Dr. Kamachi Mudali, the President of ECSI. The chief guest of the conference was Dr. C. G. Krishnadas Nair, who inaugurated the event. Dr. Rudresh briefed on the activity and achievements of the society during the Inauguration function and Prof. E. S. Dwarakadasa, CEO and MD, M/s Karnataka Hybrid Micro Devices Ltd., Bengaluru and ex-President served as the Guest of Honour for the conference. Vote of thanks was conveyed by Dr. Nagaswarupa, the General Secretary of the society.



**Memento being presented to Dr. C. G. Krishnadas Nair by Prof. Dwarakadasa and Dr. Rudresh during the Inaugural function of the two day National Conference on Advanced Lithium Ion batteries. Dr. Dinesh Rangappa, Joint Secretary of the society could also be seen.**

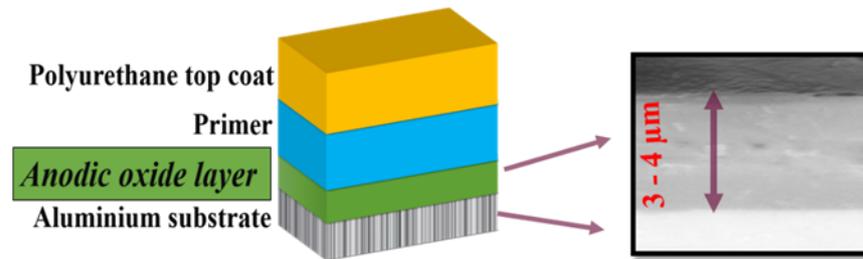
## A leap step towards a chromate-free aircraft coating system

J. N. Balaraju\*, B. Shri Prakash, Meenu Srivastava, N. T. Manikandanath  
Surface Engineering Division  
CSIR-National Aerospace Laboratories, Bangalore- 560017  
\*email: jnbalraj@nal.res.in

Aerospace is a high-end industry driven by technology and innovation. In line with the complex construction of the aircraft, in comparison to other industries, coating systems employed in the aircraft are much superior. Any window for compromise on high performance delivery is minimal in the aircraft industry and coating qualification parameters are very stringent. Despite the development of new high-performance composites in the recent past, Aluminium (Al) continues to be one of the most used materials in the aeronautic industry because of its unparalleled attractive characteristics. Being a soft material, alloying of Al with the element such as copper (Cu), followed by a heat treatment, is routinely carried out to impart the mechanical strength that is necessary to make it suitable for structural applications of the aircraft. However, addition of Cu worsens the inherent corrosion resistance property of the alloy. Coating systems, to be developed on these Al alloy components, are thus essential to play a greater role in imparting the necessary corrosion protection. Multilayered coating system encompassing pre-treatment layer, primer and top coat is methodologically developed on the aircraft surface for this purpose. Range of environmental conditions that aircraft gets subjected to during its operation makes corrosion prevention a daunting task. All this time, despite of its known carcinogenicity, in their quest to attain excellent corrosion resistance, aeronautic industries had relied heavily on hexavalent chromium ( $\text{Cr}^{6+}$ ) based formulations/compounds (chromates). Each of the layer in the coating system invariably contained varied level of chromates. For instance, chromic acid anodization (CAA): the process that has been the most sought after pre-treatment process for several decades on the structural parts of aircraft, accounts for  $\sim 30\%$  of  $\text{Cr}^{6+}$  usage in the aircraft industry. Corrosion resistance of porous anodic layer thus produced is further ameliorated through the sealing solution containing chromates. Growing environmental challenges and health concerns, however, have necessitated a concerted effort in searching for eco-friendly alternatives to mitigate the adverse impacts. Anticipating the potential regulatory framework in the near future, a proactive approach at the earliest possible stage of design is necessary, rather than implementing it as a reactive solution. As per National Aerospace Surface Finishing (NASF), USA forecast, chromate coating systems have to be phased out by 2026. At present, attempts to phase out hexavalent chromium, either through the replacement of chromate

containing primer or chromate based pretreatment processes, with more ecofriendly processes, are partially successful. Unfortunately, complete replacement of the Cr<sup>6+</sup> system with sustainable alternatives without compromising the quality and the performance has not been realized yet. In cognizant of this, CSIR-NAL has taken up a challenge to progressively replace the most hazardous substances in the aircraft coating system. Incipiently, it was aimed to attain the chromate-free pretreatment layer process in place of CAA. Pretreatment layer developed through any alternative process must be able to give the aluminium alloys: (a) corrosion protection at least in the level of CAA, (b) developed layer should have good compatibility and adhesion with post treatment layers, and (c) fatigue life reduction, if any, should not exceed the level that is induced by CAA. Many alternatives, such as, Sulphuric Acid Anodising (SAA), Boric Sulphuric Acid Anodising (BSAA) or Tartaric Sulphuric Acid Anodising (TSA), are being extensively investigated as a prospective replacement. These chromate-free anodic layers however are sealed through chromate containing solution to achieve necessary corrosion protection. Till date, anodic layer system, which are completely free of hexavalent chromium, with equivalent or superior performance to that of CAA process, has not been developed. This is highly challenging as chromate systems are highly versatile and are best in many aspects. For instance, chromate systems are known for their exceptional “self-healing” ability. A chromate coating system can repair itself if scratched or damaged, thereby providing active corrosion protection to the underlying metal. Thus, the challenge at hand is to develop an alternative coating system which not only imparts high corrosion protection ability but also possesses self-healing capabilities. In its endeavor towards realizing chromate-free coating system, as an initial step, Surface Engineering Division (SED) of CSIR-NAL has worked towards the development of chromate-free anodization process. A modified TSA process has been employed for the development of anodic layer. In order to improve the corrosion protection capabilities, porous anodic layer was further sealed using chromate-free formulation. Through the series of tests, it was confirmed that bi-elemental based in-house developed formulation not only imparts the required corrosion protection but also exhibits self-healing ability.

Self-healing ability was attributed to the synergistic effects of two elements presents in the formulation. Formulation thus developed is free of chromate, phosphate and fluoride and aptly qualifying to be called “eco-friendly”. Formulation was optimized through the coating fabrication on the coupon sized samples and evaluating them through series of electrochemical impedance spectroscopic (EIS) studies and quantifying the corrosion resistance ability through the parameter



**(a) Schematic representation of aircraft multi-layered coating system; (b) cross-sectional image of sealed anodic oxide layer developed on AA2024.**

known as corrosion current density ( $I_{corr}$ ). Apart from preliminary tests, such as, thickness measurement, microstructural and electrochemical tests, series of other qualifying tests were conducted on anodized and sealed coatings, which included salt spray test, adhesion test, outdoor exposure in the sea shore environment, etc. Developed coating has qualified all the tests and performance was found to be at par with the conventional CAA developed coatings. This process is eco-friendly and complies with RoHS and REACH environmental regulations.

A patent both national and international has been filed for this process and the clearance has been obtained for the process from RCMA (F&F-FOL), CEMI-LAC. The demonstration of the process has been successfully carried out on cast alloys, wrought welded joint, tubes and airworthiness of the process is in progress. Adapting this process will limit the discharge of harmful chemicals into the environment to a great extent. At present, the process technology has reached a TRL of 7 and is ready for commercialization.

In an effort to develop a chromate-free total coating system for aircraft, preliminary investigation has been carried out to check the efficacy of non-chromate in-house developed inorganic inhibitor containing primer. Outcome of the evaluation of these bi-layered coatings for adhesion, continuous salt spray tests are encouraging. Further investigations on the outdoor exposure in the sea shore environment for the longer duration needs to be carried out to qualify the developed non-chromate primer for aircraft applications.

An interesting webinar on **Additive Manufacturing Technique-3D Printing** was organised by CoE: Metallurgical Engineering at CMR Institute of Technology, Bengaluru, affiliate to Visveswaraya Technological University, Belgaum and member institute to ECSI, Bengaluru. The technique is useful for custom shaped layer by layer material building including those of electrochemical materials and applicable to variety of technology. The event was organised on 16, January 2021 with **Dr. P. K. Panda, Chief Scientist & Head, Materials Division, CSIR-NAL** as the speaker. Dr. Bijayani Panda Head of the CoE was the host and Dr. Chaitanya Lekshmi, member of ECSI and Dr. Sagar, Head CoE Additive Manufacturing at CMRIT, presided the meeting.



## Materials and Electrochemical Science & Technology Webinar Series

In response to the call for “Atmanirbhar Bharat Abhiyan” by the honourable Prime Minister Shri Narendra Modi for a self-reliant India, the Electrochemical Society of India has decided to organise series of webinars in materials and electrochemical science & technology jointly with Department of Nanotechnology, Visweswaraya Technological University as online teaching programme and for Academia-Research-Industry interactions. They were organised as weekly webinars held on Saturday and Sunday evenings starting 19th July 2020. The topics covered are Basic Electrochemistry and Electroanalysis, Corrosion and Material, Protection Technology, New Materials in Electrochemical Systems, Electroplating and Surface Engineering, Electrochemical Sensors and Devices/ Instrumentation, Nanoscale Electrochemistry, Environmental Electrochemistry, Electrosynthesis & Electrometallurgy / Industrial, Electrochemical Processes, Hydrogen - Electrochemical Production, Storage and applications Batteries, and Energy Storage, Electrochemical Solar Cells, Lithium-Ion Batteries, Super-capacitors & Lead Acid Batteries, Electrochemical Power Systems.

### **Some of the prominent lectures arranged have been:**

- Developing Safe Sodium Ion Battery Technology for Stationary Applications by Dr. Palani Balaya, Department of Mechanical Engineering, National University of Singapore, Singapore
- Lithium Batteries Materials: History, Introduction & Mechanisms by Dr. M. V. Reddy, Institute of Research Hydro Quebec, Centre of Excellence in Transportation, Electrification & Energy Storage, Montreal, Canada
- Polymer Electrolyte Membrane Fuel Cell-The Science and Technology by Dr. Raman Vedarajan, Scientist, Centre for Fuel Cell Technology, Advanced Research Centre for Powder Metallurgy and New Materials, IITM Research Park
- Polymer Electrolyte Fuel Cells for Stationery and Automobile Applications: Materials Challenges by Dr. Santoshkumar D. Bhat, Principal Scientist & Assoc. Professor, CSIR-Central Electrochemical Research Institute, CSIR Madras Complex, Chennai 600 113.

## One Day Online Workshop on Surface Engineering and Modification for Better Performance

A one day online Workshop on Surface Engineering and Modification for Better Performance was held on Saturday, September 19th, 2020. The objective of the program was to enable participants to know the latest trends in surface engineering of materials for strategic and industrial applications. Participants comprised of undergraduate, postgraduate students, young researchers, scientists and engineers from institutes across the country and also amidst members of ECSI.



**“High Performance Super hydrophobic Coatings for Corrosion Protection in Aggressive Environments”**

***Dr. U. Kamachi Mudali***

Distinguished Scientist & Chairman & Chief Executive Heavy Water Board (HWB) Department of Atomic Energy 5th Floor, Vikram Sarabhai Bhavan, Anushaktinagar.

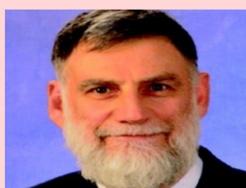
**“Tailoring anodized aluminium for optical quality design: Glossy to white”**

***Dr. Rajan Ambat***

Professor in Corrosion and Surface Engineering Materials and Surface Engineering, Building 425 Department of Mechanical Engineering Technical University of Denmark, DK 2800 Kgs, Lyngby, Denmark



The Plenary lecture was given by Dr. Kamachi Mudali, who enlightened audience on High performance Super hydrophobic coatings for Corrosion protection in Aggressive environment and dealt with the chemistry and mechanism behind the formation of protective coatings and their diversified applications. This was followed by the lecture on “Tailoring anodized Al for optical quality design: From glossy to white” by Dr. Rajan Ambat from Technical University of Denmark. The workshop also saw Prof. Chris Berndt elaborating on “Design of Microstructures for Aggressive Environments via Thermal Spray Surface Engineering” and Dr. Laxmidhar Besra speaking on “Protective coatings by Electrophoretic Deposition and Cold Spraying”. The event was part of a series of lectures organised by ECSI since July 2020 in response to the call for Atmanirbhar Bharat by the honourable Prime Minister Shri Narendra Modi, for a self-reliant India.



**“Designing Microstructures for Aggressive Environments via Thermal Spray Surface Engineering”**

***Prof. Chris Berndt***

Director SEAM: 'SEAM covers it all'. Australian Research Council, Industrial Transformation Training Centre on “Surface Engineering for Advanced Materials” University Distinguished Professor, PhD, DEng

**“Protective Coatings by Electrophoretic Deposition and Cold Spraying”**

***Dr. Laxmidhar Besra***

Chief Scientist & Head, Materials Chemistry Department & Professor-Academy of Scientific & Innovative Research (AcSIR), CSIR-Institute of Minerals & Materials Technology (IMMT) Bhubaneswar 751 -13, Odisha.



**ELECTROCHEMICAL SOCIETY OF INDIA**  
**Indian Institute of Science Campus, Bangalore 560012**  
**Tel: +91-80-2360977; +91-80-2293 2613. Email: [ecsocind@gmail.com](mailto:ecsocind@gmail.com); URL:**  
**[www.ecsi.in](http://www.ecsi.in)**

Call for Nominations  
**The N. M. SAMPATH Award 2020**

With a view to recognize outstanding services rendered to the Electroplating Industry and Technology, the Governing Council of the ECSI has accepted a Corpus of the Award Fund of the Society and has Instituted the **N. M. SAMPATH Award**. Nominations are invited for the N. M. Sampath Award 2020, which can be made by Heads of Institutions, Industries and other organizations, earlier Award winners, Fellows of ECSI, persons in outstanding positions, etc. Nominations may be submitted at any time of the year, but before the 30 May of the year for that year's award (30 November 2020). Self-nomination is discouraged.

The Award carries a scroll of honour and a cash prize. Details of earlier winners of this Award may be obtained by sending a request to the Hon. Gen. Secretary

**Guidelines for Nomination for the Award:**

1. Nomination should be specific and sent along with detailed CV of the nominee highlighting the significance of the work carried out and the impact on the Indian Industry
  2. Work in the area of Industrial Metal Finishing, Electroplating, Surface Finishing, and allied subjects would be relevant
  3. The work should be meritorious and should have promise of industrial applicability
  4. The work should have been carried out to make it suitable for Industrial application. The process of development and test schedules may have been carried out during the preceding couple of years but should have culminated in a fruitful result during the year.
  5. The work need not necessarily have been published
- Membership of the ECSI of the person nominated is not mandatory, but ECSI would encourage the recipient to become a Member of ECSI.

Nomination complete in all respects should reach the Hon. Gen. Secretary, Electrochemical Society of India, Indian Institute of Science Campus, Bengaluru 560012 on or before 30 May in the year of the Award.

**Who can nominate:**

Heads of divisions/departments/institutions in which the nominee is working. Heads of Department of Academic Institutions in which similar work is being carried out.

**ELECTROCHEMICAL SOCIETY OF INDIA**  
Indian Institute of Science Campus, Bangalore 560012  
Tel: +91-80-2360977; +91-80-2293 2613. Email: [ecsocind@gmail.com](mailto:ecsocind@gmail.com);  
URL: [www.ecsi.in](http://www.ecsi.in)

Call for Nominations

## **S. K. SESHADRI Memorial Mascot National Award 2020**

With a view to stimulate interest among Scientists, Engineers and technologists and to recognize meritorious work in the field of Corrosion, the Electrochemical Society of India accepted the Endowment offered by the President of Mascot Chemical Industries and Instituted the **Dr. S. K. Seshadri Memorial MASCOT National Award** in the year 1982. The Award will be presented annually at the National Seminar on Electrochemical Science and Technology (NSEST), which will normally be held in the middle of July/August every year. Nominations are invited and may be submitted by Heads of Institutions, earlier MASCOT Award winners, Research Supervisors, Fellows of ECSI and nationally recognised persons. Nominations may be submitted at any time of the year, but before the 30 May of the year for that year's award (30 Nov 2020). Self-nomination is discouraged.

The Award carries a scroll of honour and a cash prize. Details of earlier winners of this Award may be obtained by sending a request to the Hon. Gen. Secretary

### **Guidelines for Nomination for the above Awards**

1. Nomination should be specific and sent along with detailed CV of the nominee highlighting the significance of the work carried out and the impact on the Indian Industry
2. For the MASCOT Award, work in the area of Industrial Corrosion, Corrosion prevention and allied subjects would be relevant
3. The work should be meritorious and should have promise of industrial applicability
4. The work should have been carried out to make it suitable for Industrial application. The process of development and test schedules may have been carried out during the preceding couple of years but should have culminated in a fruitful result during the year.
5. The work need not necessarily have been published. Membership of the ECSI of the person nominated is not mandatory but ECSI would encourage the recipient to become Member of ECSI.

Membership of the ECSI of the person nominated is not mandatory but ECSI would encourage the recipient to become Member of ECSI. Nomination complete in all respects should reach the Hon. Gen. Secretary, Electrochemical Society of India, Indian Institute of Science Campus, Bengaluru 560012 on or before 30 May in the year of the Award.

## ECSI Memberships

ECSI is a vibrant Society of Scientists, Technologists, and Professionals in the area of Electrochemical Science and Technology. ECSI celebrated its Golden Jubilee during the year 2015. Graduates in Science, Engineering and Technology in any discipline are eligible to apply for its membership. However interest in one of the areas of Electrochemical Science and Technology, viz., Electrochemistry, Battery, Corrosion Science and Engineering, Protection, Surface Engineering, Electroplating and Forming, Energy Storage and Generation, Photovoltaics, Environment, Sensors and allied areas are welcome. One can choose any of the following grades of Membership:

**Life Membership:** A one time payment of Rs. 6000/- and an admission fee of Rs. 500/- entitles one to a life Membership of the Society for a period of 20 years. At the end of 20 years, a nominal payment is made to extend life membership by another 5 years.

**Fellowship of the Society:** A life member of more than two years standing may be recommended for Fellowship of the Society by two members of the Society. Fellowship of ECSI is conferred when the Governing Council accepts the recommendation. Elected Fellows pay a one time fee of Rs. 5000/- and is for life.

**Donor Member:** Corporate houses and interested individuals and Institutions shall apply for Donor Membership by making an application along with an admission fee of Rs. 1000 and a onetime fee of Rs.25,000. Upon acceptance by the Governing Council, the Donor Membership is for a period of twenty years. At the end of the 20 year period membership may be continued for a period of 5 more years by paying a fee of Rs. 10,000/-. Donor members can identify one person from their organization to enjoy membership benefits of ECSI.

**Patron Member:** Corporate and Institutions may apply for Patron Membership by paying an admission fee of Rs. 2500/- and a one time fee of Rs. 50,000/-. Upon acceptance by the Governing Council, the Patron Membership is for Lifetime. Patron Members can identify two members from their organization to enjoy membership benefits. Also, one of the members sits on the governing council of ECSI.

All the grades of members receive a copy of the Journal of the Electrochemical Society of India. They also attend Workshops, Seminars, Conferences and such other events organized by the ECSI at subsidized rates as determined from time to time.

To apply for membership, an application form has to be filled, and send along with DD for the required amount and a passport size photograph of the applicant to the below address.

## **ECSI Teacher & Student Membership**

### **Teacher Member:**

Teachers of recognized Colleges may opt for becoming Teacher Members of ECSI. They shall pay an admission fee of Rs. 200/- and a fee of Rs. 2000 along with the application. They enjoy full Membership benefits of ECSI.

### **Student Member:**

Bonafide students shall be admitted as Student Members of ECSI upon paying an admission fee of Rs. 100/- and a fee of Rs. 1000/-. The tenure of the Student Membership is as long as the member maintains the student status. After graduation, student has the option to convert to Life Membership by paying the required transfer fee. Student members enjoy free attendance at all events organized by the society. However, at each of the events, prior registration is mandatory.

ECSI particularly welcomes Teachers and Students to become members and take active part. Benefits include attending the various seminars, conferences and workshops organized by the Society from time to time, using the books in the library of the society, play a leadership role by joining the Governing Council of ECSI, publish in the Journal of ECSI, act as co-editors for JECSEI, organize lectures and short term courses, form branches of ECSI, and many more. NSEST, the National Seminar on Electrochemical Science and Technology, held every year during the month of July, is of particular interest to student and teacher community. From among the student delegates presenting papers, best paper awards are given.

To apply for membership, an application form has to be filled, and send along with DD for the required amount and a passport size photograph of the applicant to the below address.

**Hon. Gen. Secretary,  
Electrochemical Society of India,  
Indian Institute of Science Campus,  
Bengaluru 560012**

*Note:* Arrangements are underway to make it possible to file the application online through ECSI website soon.

## ECSI Membership-Application

<b>MEMBERSHIP APPLICATION</b>	 <p><b>THE ELECTROCHEMICAL SOCIETY OF INDIA</b>                  Indian Institute of Science Campus, Bangalore - 560 012                  Tel : 23600977, 22932613 Fax : 91-80-23600685                  Attn.ECSI Grams : SCIENCE. e-mail : ecsi@ureach.com</p>	Attach A Most recent Stamp Size Photo.
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Name _____ Company / Organisation _____ Address _____ _____ Pin Code <input type="text"/> <input type="text"/> Telex : _____ Grams : _____ Telephone _____ House Address _____ _____ Pin Code <input type="text"/> <input type="text"/> _____ Telephone _____	Attach a most recent Passport size photograph 25 x 40mm or smaller (Colour preferred)
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SEND MAIL TO <input type="checkbox"/> Business Address <input type="checkbox"/> Home Address Birth Date _____ Place _____ MM DD YY Membership Status <input type="checkbox"/> Fellow <input type="checkbox"/> Member <input type="checkbox"/> Donor <input type="checkbox"/> Student <input type="checkbox"/> Fresh <input type="checkbox"/> Transfer <input type="checkbox"/> Life Member <input type="checkbox"/> Patron <input type="checkbox"/> Life Fellow	Primary Fields of Interest Write any six fields in order of preference (see reverse for codes) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
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EDUCATION					
Name of College / University	Date attended	Degree	Date	Subject	
	From To				

**RECORD OF EXPERIENCE :** List in chronological order your employment Data. Include nature of duties, responsibilities, especially connections with electrochemical fields.


I agree, if elected, to accept election and abide by the constitution and Bylaws of the Society.

A DD for the amount Rs..... DD No..... Date..... on Bank ..... is enclosed.

Place ..... Date..... Signature .....



## THE ELECTROCHEMICAL SOCIETY OF INDIA

Indian Institute of Science Campus, Bengaluru – 560 012



*Cordially invites you for the*

**12<sup>th</sup> Dr. S. Krishnamurthy Memorial Lecture**

**Dr. M. Jagadish**

Vice President & Chief Technology Officer

Amara Raja Batteries Ltd.

Karakambadi, Andhra Pradesh

on

**“Present and Future Trends on  
Electrochemical Energy Storage Technologies for  
Green Transportation of Vehicles”**

**Dr. U. Kamachi Mudali**

**President, ECSI, will preside over**

**at 3.00 P.M, Thursday, 21<sup>st</sup> January, 2021**

**via Cisco Webex Online**

**Dr. Nagaswarupa H.P**

**Gen. Secretary. ECSI**

*All are Welcome!*

**THE ELECTROCHEMICAL SOCIETY OF INDIA**

Indian Institute of Science Campus, Bengaluru – 560 012

*Cordially invites you for***17<sup>th</sup> Prof. S.M. Mayanna Endowment Lecture***by***Dr. M.V. Reddy****Institute of Research Hydro Quebec,  
Centre of Excellence in Transportation, Electrification and Energy Storage  
Montreal, Canada***on***“Advances in Materials and Electroanalytical techniques  
for Energy Storage Techniques ”****Dr. U. Kamachi Mudali****President, ECSI, will preside over****at 4.30 PM, Thursday, 21<sup>st</sup> January, 2021  
via Cisco Webex Online****Dr. Nagaswarupa H.P  
Gen. Secretary. ECSI***All are Welcome!*



# The Electrochemical Society of India (ECSI)



and

Department of Nanotechnology,  
Visvesvaraya Technological University

Weekly webinars on

## Materials and Electrochemical Science and Technology

This Lecture Series is to provide an opportunity to Students, Research Scholars, Faculty, Scientists and industry people to enrich and update their knowledge in the field.



Every Saturdays & Sundays, Starting 19<sup>th</sup> July 04.00 pm to 05.30 pm

### Topics covered:

**Basic Electrochemistry and Electro-analysis, Corrosion and Material, Protection Technology New Materials in Electrochemical Systems, Electroplating and Surface Engineering, Electrochemical Sensors and Devices/ Instrumentation, Nanoscale Electrochemistry, Environmental Electrochemistry, Electro synthesis & Electrometallurgy / Industrial, Electrochemical Processes, Hydrogen - Electrochemical Production, Storage and applications Batteries and Energy Storage, Electrochemical Solar Cells, Lithium Ion Batteries, Super-capacitors & Lead Acid Batteries, Electrochemical Power Systems.**

Dr. U. Kamachi Mudali  
Hon. President ECSI

Prof. Nagaswarupa H. P.  
Hon. Gen. Secretary ECSI

### Coordinator:

Prof. E. S. Dwarakadasa  
Past President ECSI

Prof. Dinesh Rangappa  
Hon. Gen. Joint Secretary  
ECSI

Those who wish to have certificate should pay Rs.100/- as fee.

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I.I.Sc. Bengaluru



For any query:  
ecsiisc@gmail.com

Registration Link:

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