

CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE

Your Destination for Innovative Research...



**A UNIQUE R&D HOUSE FOR BASIC AND APPLIED RESEARCH IN
ELECTROCHEMICAL SCIENCE AND TECHNOLOGY**



CECRI
www.cecni.res.in

A Constituent Laboratory of CSIR
Department of Scientific and Industrial Research
Government of India

The Central Electrochemical Research Institute (CECRI), Karaikudi was founded on 25th July 1948. It has grown by leaps and bounds with three extension centers located at Chennai, Mandapam and Tuticorin. CECRI has been recognized as one of the premier R&D laboratories and plays a vital role in the industrialization of our nation with 225 processes, 710 patents, 320 sponsored/grant-in-aid projects, 5000 research and review articles. It has more than 420 licensees. Apart from engaging in basic and applied research, CECRI assists the industry by undertaking consultancy projects. The Institute conducts short-term refresher courses for the benefit of industrial houses and educational institutions. As part of its human resource development programme, CECRI runs Anna University's B.Tech. (Chemical and Electrochemical Engineering) and M.Tech. (Electrochemical Engineering) programs. Researchers and doctoral students from this part of the country make good use of the excellent library as well as the analytical and characterization facilities of the Institute. CECRI organizes national and international conferences for the dissemination of scientific knowledge. It is also alive to societal obligations and participates in activities such as entrepreneur development and CSIR's youth development program.

AREAS OF RESEARCH

Corrosion Science and Engineering



Corrosion monitoring of port structures

CECRI has a large multi-disciplinary group of scientists working on various aspects of corrosion and its control systems. CECRI as a lead laboratory in this area has developed a number of anti-corrosion products and processes. It has expertise in corrosion control in concrete structures, cathodic protection of buried and marine structures, structural health monitoring system, bio-corrosion, development of corrosion inhibitors and protective organic coatings, surface engineering, corrosion monitoring, failure analysis and environmental corrosion.

Electroplating and Metal Finishing

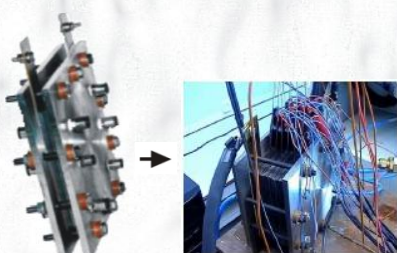


Continuous wire plating

A large volume of work has been carried out in the last four decades on both theoretical and applied aspects of metal finishing such as high-speed plating, electroforming, electropolishing, conversion coatings, metal coloring, plating formulations, and selective coatings for solar energy utilization.

Expertise is available in electroforming of tools and dies, hard anodizing, AC anodizing, lead plating on aluminium, chromium plating, nickel-iron plating, black nickel plating, platinum plating on titanium, etc.

Electrochemical Power Systems

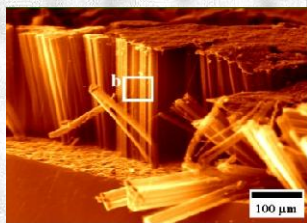


Fuel cell

Stack

This Division undertakes research programs on different types of power systems and also offers consultancy as well as remedial measures for problems referred by industries. The Division has expertise in the field of lead-acid batteries, deep-discharge batteries for photovoltaic applications, maintenance-free batteries for UPS and defence applications, prudent lead-acid batteries for stand-alone solar photovoltaic applications, vented and sealed Ni-Cd batteries for aircraft applications, nickel-iron batteries for AC coaches and railway signaling, Ni-MH and variety of lithium batteries for EV applications, magnesium-silver chloride batteries for merchant navy and defence, and hydrogen-based fuel cells (PEFCs, SPE-DMFCs, DBFCs) for multifarious applications.

Nano-scale Electrochemistry



Carbon nanotube bundles grown on a silicon substrate



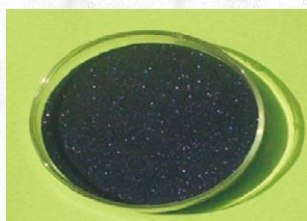
Bismuth-filled carbon nanotubes



PEM electrolyzer for hydrogen generation



Recovery of copper from etchants



Samarium hexaboride

Nanomaterials are set to revolutionize device applications, including batteries. The nanomaterials group at the Electrochemical Power Systems Division has demonstrated the superior qualities of nanometric electro-active materials for lithium-ion batteries. Activities of this group center on the following:

- ▣ Production of aligned carbon nanotube bundles and study of growth mechanism
- ▣ Metal-filled carbon nanotubes as a novel class of lithium-insertion anodes
- ▣ High-capacity, long-cycling graphitic anodes
- ▣ A filth-to-wealth program for the production of graphitic anodes from plastic wastes
- ▣ Nanocrystalline cathode materials by solution combustion method
- ▣ Nanocoatings for enhanced cyclability of lithium battery cathodes.

Electrochemicals

The major benefits offered by the electrochemical route include precise and easier control of reactions, low operating temperatures, minimum wasteful by-products, reduced running costs and high purity chemicals. Expertise includes modernization of mono-polar cells, bipolar and annular flow cells, trickle-bed and packed-bed cells for chlorates, bromates, iodates, hypochlorite, hydrogen peroxide, calcium gluconate, solid polymer electrolyte cell for hydrogen, electro-organic and inorganic syntheses, electrochlorination, electrodialysis, TSI anode, membrane cell, electrochemical dyeing, etc.

Electrohydrometallurgy

CECRI has expertise in the area of electrowinning and electrorefining of non-ferrous metals, electrolytic recovery of silver, chromium, gallium, nickel and lead, lead recovery from spent lead-acid batteries, industrial effluent treatment, recovery of copper from etchants like ferric chloride and ammoniacal cupric chloride of PCB industries with simultaneous regeneration of etchants, and recovery of metals from secondary sources.

Electropyrometallurgy

The Electropyrometallurgy Division is committed to developing electrolytic processes for the production of reactive metals and alloys like magnesium, magnesium-lithium, aluminium, sodium, calcium and rare earth metals, refining of metals like aluminium through molten salt electrolysis, etc. It is also involved in the preparation of high-temperature high-tech materials like hexaborides of rare earths and magnetic materials containing rare earth metals. Development of processes for the preparation of magnesium-lithium alloy and hexaborides of samarium and neodymium are in progress.

Functional Materials

This Division primarily conducts R&D works a novel energy materials in conjunction with computer/modeling. R&D work is also focused on organic materials for polymer light-emitting devices, conducting polymers and their components for sensor, electrocatalytic and EMI Shielding applications.

Electrodics and Electrocatalysis

CECRI addresses itself to frontier areas of electrochemistry comprising fundamental electrochemistry, kinetics of electrochemical processes, interfacial phenomena including biological interfaces, electrocatalysis, electroanalysis, electrochemical sensors and modeling, and simulation of electrochemical processes. Technologies developed are ion-selective electrodes for copper, silver, lead, mercury, chloride, bromide, iodide and cyanide ions.

Electrochemical Materials Science

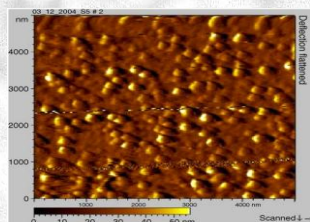
This Division has specialized knowledge and skills in preparing thin films of transparent conducting oxides, transition metal chalcogenides and metal/alloy nitrides, which find extensive applications in opto-electronic, electrochromic, photoelectrochemical and biomedical implant devices. Expertise is available to prepare these thin films using various techniques like vacuum/electron beam evaporation, RF/DC magnetron sputtering, sol-gel spin coating, spray pyrolysis, and pulse and brush plating. Electrochemical and spectral characterization of semiconductor thin films and nano powders are the strengths of the Division.

Pollution Control

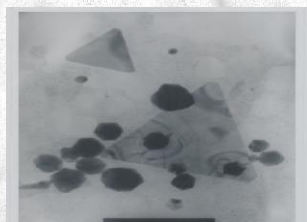
R&D activities of this Division are to provide cleaner technology with the ultimate goal of achieving zero discharge principles. It has expertise in recovery of metal ions, destruction of toxic chemicals in liquid wastes, treatment of effluent from tanneries, pesticide industries, electroplating and metal finishing industries, and destruction of pollutants such as phenol, cresol and anthraquinone from effluents of chemical industries.

Electrochemical Instrumentation

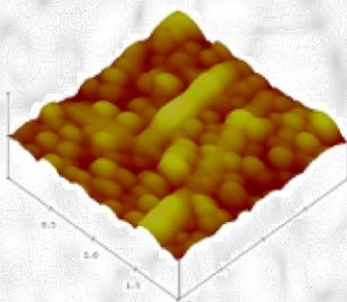
This Division is engaged in the design and development of instruments for electrochemical applications such as potentiostat, hydrogen permeation monitor, BOD analyzer, RCC corrosion monitor, coating integrity monitor, atmospheric corrosion monitoring system, computerized electrochemical analyzer, electrochemical process monitoring systems using Labview, SCADA, four-probe concrete resistivity logger, battery IR meter etc.



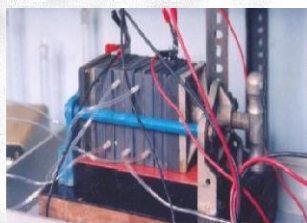
AFM image of silver nanoparticles stabilized in stearic acid matrix



TEM image of Au_{nano} - PEDOT



AFM image of Mg,SnO, nano-rods and spherical grains



Electrochemical ion-exchanger



Concrete resistivity logger

Modern Central Instrumentation Facility for Advanced R&D

- ❖ Powder X-ray Diffractometer
- ❖ X-ray Fluorescence Spectrophotometer
- ❖ Thermal Analysis System (TG and DTA)
- ❖ Differential Scanning Calorimeter
- ❖ Gas-liquid Chromatograph
- ❖ Gel Permeation Liquid Chromatograph
- ❖ High-performance Liquid Chromatograph
- ❖ Advanced Ion Chromatograph
- ❖ Laser Particle Size Analyzer
- ❖ BET Surface Area Analyzer
- ❖ FTIR Microscope
- ❖ Metallurgical Microscope & Micro Hardness Tester
- ❖ Scanning Electron Microscope
- ❖ Scanning Vibrating Electrode Technique (SVET)
- ❖ Kelvin Probe Setup
- ❖ Atomic Force Microscope
- ❖ Scanning Tunneling Microscope

- ❖ Laser Raman Spectrometer
- ❖ NMR Spectrometer
- ❖ X-ray Fluorescence Thickness Gauge
- ❖ Slow Strain Rate Stress Corrosion Testing Machine
- ❖ Atomic Absorption Spectrophotometer
- ❖ UV-VIS-NIR Spectrophotometer
- ❖ Fourier Transform Infra-red Spectrophotometer
- ❖ CHN Analyzer
- ❖ DC Magnetron Sputtering Unit
- ❖ Electron Beam Evaporation Unit
- ❖ Universal Tensile Testing Machine
- ❖ CNC Milling Machine
- ❖ ESR Spectrometer
- ❖ Transmission Electron Microscope
- ❖ Cluster Computers
- ❖ ICP Mass Spectrometer



Library and Information Services

CECRI Library has a unique collection of resources in the field of electrochemistry and allied disciplines being served to scientists and scholars. It has 48000 books and back volumes of journals, around 7500 patents, 2800 standards and 2700 technical reports. The library is automated its resources and transactions. It has access to over 3500 online journals in various fields. The library serves as a knowledge centre for the students of B.Tech. and M.Tech. at CECRI. It also extends its services to the researchers and students from various colleges, universities, industries and other research laboratories.

Current Research Programs

- ❖ Solid ionic materials and conducting polymers
- ❖ Electroluminescent and phosphor materials
- ❖ Microporous materials
- ❖ Conducting polymer based protective coatings
- ❖ Polymer amine corrosion inhibitor for iron in acid solution
- ❖ Nanoparticle filled silicone coating for corrosion
- ❖ Micro-sensors
- ❖ Development of temperature sensitive paints
- ❖ Green technologies for organic chemicals
- ❖ Industrial waste minimization
- ❖ Coating and re-coating of anodes and cathodes of membrane cells for the production of caustic soda and chlorine
- ❖ Plating for electronic applications
- ❖ Clean technologies for electroplating
- ❖ Electroplating of nanoparticle dispersed metal matrix composites
- ❖ Ozone friendly perfluorocarbon and hydro-fluorocarbon
- ❖ Perfluoroalkane sulphonamide based lithium salts for battery and fuel cells
- ❖ Microemulsion electrochemical synthesis, analysis and detoxification
- ❖ Creation of energy storage devices using nanostructure unit materials

- ❖ Prudent lead-acid battery for photovoltaic system
- ❖ Polymer electrolyte fuel cells (PEFC) based on hydrogen
- ❖ Direct borohydride fuel cell (DBFC)
- ❖ Low cost lead-acid battery with high specific energy
- ❖ Industrial grade sealed nickel-iron 12V/60 Ah alkaline accumulators
- ❖ Polymer electrolyte membrane (PEM) electrolyser for hydrogen production
- ❖ Removal of arsenic, fluoride, nitrate from drinking water
- ❖ Nanomaterials and nanostructured electrodes for electrocatalysis and sensors
- ❖ Bio-fuel cells
- ❖ Methanol sensors for fuel cells
- ❖ Mathematical modeling and simulation of electrochemical systems
- ❖ Recovery of valuable materials and management of e-waste
- ❖ Cathodic protection of pipelines, jetties and wharf
- ❖ Microbial corrosion in oil transportation pipelines
- ❖ Corrosion audit in industries
- ❖ Corrosion and force monitoring of pre-stressed cables
- ❖ Health assessment of special structures
- ❖ Semiconductor oxide materials for electrochromic devices and solar cells

Aditya Birla Industries
Amara Raja Batteries Ltd.
Applied Materials Inc., USA
Asian Paints
Berger Paints
Bhabha Atomic Research Centre
Columbian Chemicals Company, USA
Defence Metallurgical Research Laboratory
Defence Research & Development Organisation
Department of Atomic Energy
Department of Biotechnology
Department of Ocean Development
Department of Science & Technology
Devcon Chemicals Pvt. Ltd.
Exide Industries Ltd.
General Motors Technical Center, USA
Godrej & Boyce
Gujarat Heavy Chemicals Ltd.
High Energy Batteries (India) Ltd.
Hindustan Lever Ltd.
Indian Railways
Indian Space Research Organisation
Intl. Partnership for the Hydrogen Economy(EU)
Japan Science & Technology Agency, Japan
Krishna ConChem Products Pvt. Ltd.
Madras Rubber Factory (MRF)
Ministry of Environment & Forests
Ministry of Information Technology
Ministry of New and Renewable Energy
National Highways Authority of India
Naval Dockyard
Naval Science & Technological Laboratory
NED Energy Ltd.
Nerolac Paints
Neyveli Lignite Corporation Ltd.
Nuclear Power Corporation of India Ltd.
Oil & Natural Gas Commission
Protektol Anticorrosives
Southern Petrochemical Industries Corp.
Time Technoplast Ltd.
Titanium Equipment & Anode Mfg. Co. Ltd.
Yonsei University, South Korea

CAMPUS...



GUEST HOUSE



HEALTH CENTRE



SCHOOL

OUR OUTREACH...

CHENNAI

This Center is engaged in R&D on the electrochemistry and electrochemical engineering aspects of fuel cell components and systems. The current activities focus on building newer components for the design and development of direct methanol fuel cell (DMFC) direct borohydride fuel cell (DBFC), super capacitors and solid state electrochemical solar cells.

MANDAPAM

This Center is located at a wind swept weather-beaten place where a strip of land projects into the sea, between Gulf of Mannar and Palk Strait and engaged in atmospheric corrosion, marine corrosion and bio-fouling studies.

TUTICORIN

This Center conducts a wide spectrum of marine studies such as marine corrosion, marine pollution and frontier areas of bio-electrochemistry.

CECRI Offers

- ✓ Technology, sponsored R&D, consultancy and technical services
- ✓ Setting-up knowledge alliance with private industries
- ✓ Setting-up incubation centers
- ✓ Setting-up special purpose vehicles (SPVs)

For Further Details

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Karaikudi is located at latitude of 10.06° and longitude of 78.8° . It is situated about 450 km south of Chennai on the Chennai-Rameswaram rail route and about 90 km from Madurai and Tiruchirappalli. Both Madurai and Tiruchirappalli have airlinks. CECRI campus has unique bird life and is amply green and serene.