CSIR IN THE SERVICE OF THE NATION

Central Electrochemical Research Institute (CECRI)

Karaikudi - 630 006

The Central Electrochemical Research Institute, founded in 1948, took roots in the patriotic fervor of Dr RM Alagappa Chettiar, Pandit Jawaharlal Nehru and Dr Shanthi Swarup Bhatnagar. On 14 January 1953, CECRI became a physical reality when Dr S Radhakrishnan dedicated CECRI, the twelfth national laboratory under CSIR, to the nation.

CECRI today is a proud family of 427 employees, 137 of whom are scientists. It represents the largest research establishment for electrochemistry in South Asia. Headquartered at Karaikudi in a sprawling campus of 300 acres with a laboratory space of 65,000 m^2, it has three extension centers located at Chennai, Mandapam and Tuticorin.

CECRI today is a launching pad for a multitude of technologies for the Indian electrochemical industry. The fact that the inimitable Dr Alagappa Chettiar donated 300 acres of land and Rs. 15 lakh in cash in 1948 to establish a national laboratory devoted solely to electrochemistry at a time when electrochemistry was relegated to the flip-side of Physical Chemistry syllabi in universities, one cannot miss the rare philanthropy and foresightedness of this great visionary.

CECRI's Expertise

In living up to its *raison d'etre*, the Institute works on a gamut of problems covering all facets of electrochemical science and technology: Corrosion Science and Engineering, Electrochemical Materials Science, Functional Materials, Nanoscale Electrochemistry, Electrochemical Power Sources, Electrochemical Pollution Control, Electrochemicals, Electrodics and Electrocatalysis, Electrometallurgy, Industrial Metal Finishing, and Computer Networking and Instrumentation.

Council of Scientific & Industrial Research
New Delhi

Thus, the Institute provides a unique canopy under which all aspects of electrochemistry and related areas are researched upon in all their dimensions. CECRI's activities are thus directed towards development of new and improved products and processes as well as novel innovations in electrochemical science and technology. CECRI runs several projects in collaboration with laboratories from within and outside India. Some areas where CECRI has made significant contributions are given below.

Strategic Areas

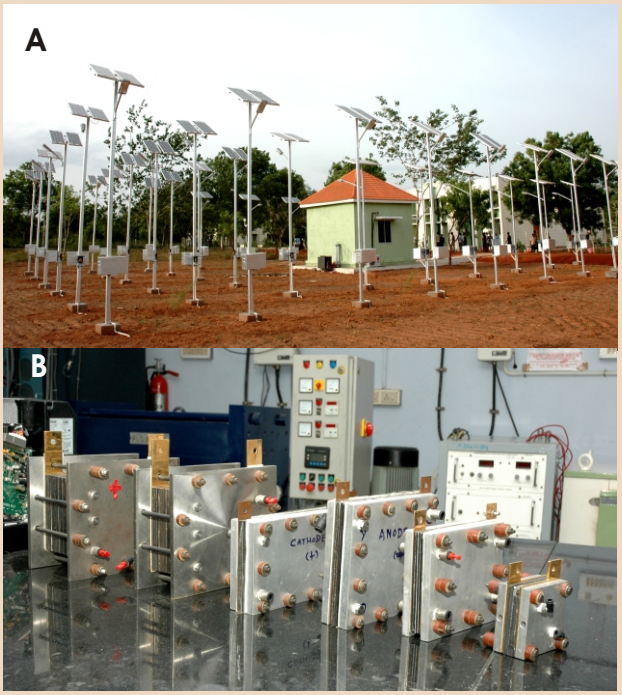
As a true participant in nation building, CECRI takes up technology development programmes in strategic areas such as defence, space, and atomic energy. These include technology for electrowinning of calcium metal, corrosion protection of missile components, preparation of nitrogen pentoxide, and development of conducting polymer for EMI shielding of radar transmitter cabinets. CECRI scientists have also made major contributions in electroforming technology as applied to cryogenic rocket engine thrust chambers. The development of such a cost-effective, indigenous technology is a boon for India's rapidly expanding space programme leading to savings of millions of rupees in foreign exchange. The development of titanium substrate insoluble anode (TSIA) is another benchmark achievement by CECRI.

Corrosion Protection

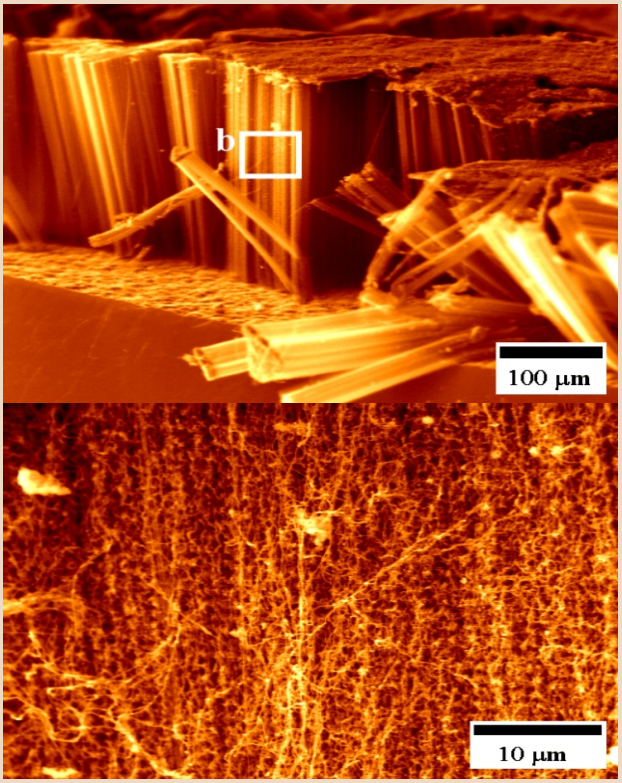
CECRI's technological breakthroughs in the area of corrosion protection, especially relating to steel structures, are well known. A technology for cement polymer composite coating system developed by CECRI has found wide application in bridges, flyovers and multi-storey buildings, and is superior to similar technologies available in India and elsewhere. Other areas of note include coatings, paints, inhibitors and surface treatments for a variety of corrosion protection strategies; paint systems for fluorescent and reflective sign boards; corrosion protection of Portland pozzolana cement structures; corrosion monitoring by harmonic analysis; corrosion-resistant composites for aerospace and military applications; and *in situ* localized corrosion analysis.

Electrodics and Electrocatalysis

Expertise available under this category relates to ion-selective electrodes, low self-noise Ag/AgCl electrodes, cost-effective diagnostic kits, sensors for methanol, calcium ions, dopamine and uric acid, portable kit for the determination of arsenic in groundwater, nano-composites for molecular recognition, etc.



(A) Photovoltaic battery testing station
(B) Polymer electrolyte fuel cells/stacks



Top and above:
Aligned carbon nanotube bundles

On-line health monitoring system for cable-stay bridge on Yamuna river

More than half the number of flyovers in Mumbai have used processes developed by the Central Electrochemical Research Institute. The Institute has also been involved in the monitoring of chemical treatment of desalinated water for the Tamil Nadu Water Supply and Drainage Board, development of lithium batteries, and removal of the oxide layer from the inner surface of pressure tubes for the Nuclear Power Corporation of India Limited.

Electrometallurgy

CECRI has developed a number of technologies for electro hydro- and electropyro-metallurgical processes. An important contribution relates to recovery of gallium from Bayer liquor. Other notable technologies include those for regeneration of spent PCB etchants and simultaneous recovery of copper, production of high-purity electrolytic manganese dioxide, recovery of tungsten as ammonium paratungstate from tungsten scrap, production of magnesium from magnesite and seabitterns, non-carbon anodes for eco-friendly aluminum electrolysis, high-purity calcium, production of misch metal, etc.

Electrochemicals

Technologies for a variety of organic and inorganic chemicals have been developed at CECRI. Particular mention must be made of research in perfluorocarbon chemicals, electrofluorination, electrochemistry of metals and semiconductors in fluoride media, titanium substrate insoluble anode (TSIA), and catalytic electrodes and cation exchange membranes for chlor-alkali and other industries. The development of TSIA brought about a technological revolution in the electrolytic production of chlorates. The impact of the technology may be gauged in terms of the total power saved (6300 million kWh at a cost of Rs. 12.7 billion) up to March 2007. CECRI has also developed a number of gadgets for domestic/community/industrial use such as PEM-based hydrogen generator, electrochemical de-fluoridator and electrochemical de-arsenator.

Electrochemical Metal Finishing

Some of the major programmes that CECRI has undertaken in the area of industrial metal finishing include cadmium plating on maraging steel parts of SARAS aircraft, electroplating of cadmium on light combat aircraft uplock components made of maraging steel, minimization of waste and recovery of reusables in plating industries, plating on aluminum alloy component hardware used in satellites, electrodeposition of aluminum from organic bath, hydrogen embrittlement-free cadmium plating on maraging steel cadmium plating over tungsten alloy, high-efficiency etch-free chromium plating, hard chromium plating, anodizing of aluminum, titanium, etc., Electropolishing/coloring of aluminum and stainless steel, electrodeposition of nanocrystalline metals, polymer coatings on anodized aluminum, etc.

Electric Vehicles

Under a programme sponsored by the Ministry of Non-Conventional Energy Sources, and in collaboration with the Banaras Hindu University, Varanasi and Defence Metallurgical Research Laboratory, Hyderabad, CECRI is developing high-energy nickel-metal hydride batteries for electric vehicles. In a recent breakthrough towards realizing low-cost lightweight and high specific energy lead-acid batteries, scientists at CECRI and the Indian Institute of Science, Bangalore developed lead-coated acrylonitrile-butadiene-styrene terpolymer grids as a replacement for the heavy solid lead grids. This reduced battery weight by as much as 75 per cent. Currently used lead-acid car batteries typically weigh about 20 kg while the new battery, delivering the same energy, will weigh only 12 kg.

Fuel Cells

In 2004 CECRI was selected as one of the nodal laboratories for R&D on hydrogen-based fuel cells under the New Millennium Indian Technology Leadership Initiative. Such an R&D program is seminal for the country since hydrogen has come to be seen as the ultimate fuel for the future. In a short span of two years, CECRI developed and demonstrated self-sustainable polymer electrolyte fuel cell stacks for portable power applications, clearly establishing its capability to fructify a concept into a product.

In recognition of this noteworthy contribution, prestigious clean energy projects for cutting-edge R&D on hydrogen-based fuel cells and next-generation lithium batteries have been awarded to CECRI during the Eleventh Five Year Plan. CECRI has also developed a 5-kW capacity PEM electrolyzer capable of delivering pure hydrogen. The main advantage of the unit is that the hydrogen generated can be pressurized in the electrolyzer itself.

CECRI and Society

CECRI assists the Indian industry by conducting surveys and undertaking consultancy projects. The institute also conducts short-term refresher courses for the benefit of the industry and academia. Researchers from this part of the country make good use of the excellent library as well as the state-of-the-art analytical and characterization facilities at the Institute.

Centre for Education

As part of its human resource development programme, CECRI's Center for Education runs Anna University's B. Tech. Course in Chemical & Electrochemical Engineering. The eight-semester B. Tech. course is unique in that it is the world's first technology programme in chemical and electrochemical engineering. These courses are recognized by the All India Council for Technical Education and the Indian Institute of Chemical Engineering.

The development of titanium substrate insoluble anode (TSIA) at CECRI led to a total power saving of 6300 million kWh at a cost of Rs. 12.7 billion up to March 2007!

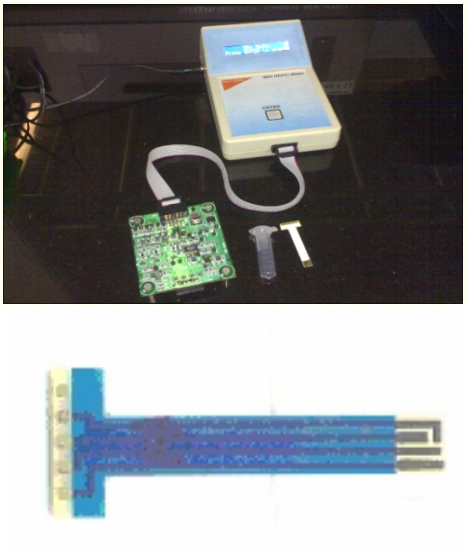
And quite recently, CECRI came up with lightweight car batteries that could be a boon for electric cars of the future.

Developing cost-effective technologies to meet global needs has been the hallmark of CECRI. Over the years, it has helped solve problems relating to corrosion science and engineering, batteries and fuel cells, electrochemical materials science, functional materials, industrial metal finishing, electrometallurgy, electrodics and electrocatalysis, nanoscale electrochemistry, electrochemical instrumentation and pollution control.

Recently, CECRI has developed India's first push-button type 'HbA1c Meter' in collaboration with Nicholas Piramal India Limited. This measures glycated hemoglobin and hemoglobin in blood samples. This is particularly useful in the management of diabetes mellitus.

CECRI also organizes national and international conferences for dissemination of scientific knowledge. CECRI is alive to societal obligations and participates in such activities as entrepreneur development and CSIR's youth development programme. CECRI is recipient of several technology awards for its telling service to Indian industry.

To say that the Central Electrochemical Research Institute is the mainstay of electrochemical industry in India is to state the obvious. And perhaps it would not be wrong to say that the history of CECRI is the history of electrochemistry in India.



HbA1C Sensor

Facilities at CECRI

Atomic Absorption Spectrophotometer
Atomic Force Microscope
Battery Cycle Testing Unit
BET Surface Area Analyzer
CHN Analyzer
Cluster Computer
CNC Milling Machine
Corrosion Fatigue Testing Unit
DC Magnetron Sputtering Unit
Differential Scanning Calorimeter
Electron Beam Evaporation Unit
Electron Spin Resonance Spectrometer
FTIR Microscope
Gel Permeation Liquid Chromatograph
High Performance Liquid Chromatograph
Inductively-coupled Plasma Mass Spectrometer
Ion Chromatograph
Laser Raman Spectrometer
Metallurgical Microscope and Micro-hardness Tester
Scanning Electron Microscope with EDAX
Nuclear Magnetic Resonance Spectrometer
Particle Size Analyzer
Powder X-ray Diffractometer
Scanning Tunneling Microscope
Scanning Vibrating Electrode Technique (SVET)
Slow Strain Rate Stress Corrosion Testing Machine
Tensile Testing Machine
Thermal Analysis System (TG and DTA)
Transmission Electron Microscope
Universal Tensile Testing Machine
UV-VIS-NIR Spectrophotometer
X-ray Fluorescence Thickness Gauge
X-ray Photoelectron/Auger Electron Spectrometer

X-ray Photoelectron Spectrometer

Inductively-coupled Plasma Mass Spectrometer

Nuclear Magnetic Resonance Spectrometer

GC/MS

Transmission Electron Microscope

For more information contact:
Director , Central Electrochemical Research Institute
Karaikudi 630 006, Tamil Nadu, India.
Phone: 91-4565-227777, 91-4565-227778
Fax: 91-4565-227779 , 91-4565-227713
E-mail: director.cecri@gmail.com
URL: www.cecri.res.in