

III AUTONOMOUS BODIES

III - A. COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

1. INTRODUCTION

The Council of Scientific and Industrial Research has established a network of national laboratories/institutes in various parts of the country to undertake research in diverse fields of science and technology and with emphasis on applied research and utilization of research results. There are at present 38 research establishments in different parts of the country, including five regional research laboratories. Some of the establishments have set up experimental, survey or field stations to further their research activities and 39 such stations attached to 16 laboratories are functioning at present.

2. SIGNIFICANT DEVELOPMENTS

SARAS takes to skies

SARAS, India's first indigenously developed, multi-role civilian aircraft will serve as a feeder airline (as executive transport and light cargo carrier) and for air taxi operations. It would also be used in remote sensing, aerial research, coast guard, border patrol, air ambulance and other services. It can take off and land from short semi-prepared runways and is therefore ideally suited for operations in difficult terrains and would help in providing connectivity, especially in the North East India.

A new TB vaccine

Tuberculosis (TB) is the leading infectious killer of youth and adults. One third of the world's population is currently infected with the causative organism, Mycobacterium tuberculosis, a gram-positive bacterium. A candidate vaccine has successfully been

evaluated in the form of live Mycobacterium habana in animals.

TB molecule breakthrough

As a result of private-public partnership programme, launched by New Millennium Indian Technology Leadership Initiative (NMITLI), a new molecule, 'sudoterb' for the treatment of TB has been developed, for which clinical trial has been started. This is the first new molecular strain discovered after Rifampycin in 1963. The molecule, which may help reduce the treatment time from eight months to two months, is especially well suited for poor.

A biomarker for the diagnosis of visceral leishmaniasis

IICB identified the increased presence of disease specific biomarker (glycotype) on erythrocytes of patients with visceral leishmaniasis (VL). The over expression of this biomarker has helped in the development of erythrocyte binding assay to monitor the clinical status of VL patients, which can detect VL even under field conditions. The potential of this discovery has been quickly identified by World Health Organisation (WHO) for its global application and the technology has recently been transferred to an Indian company (Zephyr Biomedical, Goa).

VaxiPred- computer aided vaccine design

VaxiPred, an innovative immuno-informatics tool enabled computer aided vaccine design has been released. This research tool contains components, which synergistically and seamlessly combines the best of research in

immunology and immuno-informatics, the offshoot of information technology. VaxiPred is primarily the result of premier research in vaccinology at IMTECH, which has been adequately backed and supported by use of state-of-the-art in information technology by BioMantra.

ISFET (Ion-Sensitive Field-Effect Transistor)- based glucose biosensor

CEERI has developed ISFET based glucose biosensor, which comprises an ion-sensitive field-effect transistor (ISFET) - a metal-oxide-semiconductor field-effect transistor (MOSFET) with the metal gate replaced by a chemical membrane ($\text{SiO}_2\text{-Si}_3\text{N}_4$) responsive to hydrogen ions, producing a solid-state pH-micro-sensor. This has the advantage over conventional biosensor in terms of smaller size, robustness, easy cleaning, minimal need for maintenance, and fast response.

Optical fibre amplifier

For the first time in India, an optical amplifier for light wave telecommunication network has been developed by CGCRI using erbium-doped optical fibre (EDF) and power semiconductor pump laser source. This device has the potential for use in the propagation of “Fibre to Home” technology in the country.

Traditional knowledge protection

Two NISCAIR journals, Indian Journal of Traditional Knowledge (IJTK) and Medicinal and Aromatic Plant Abstracts (MAPA), have become part of Non Patent Literature (NPL) of the PCT Minimum Documentation. For the first time journals from a developing country have been included in the coveted list of ‘prior art search journals’. Inclusion of IJTK in the list is yet another feat towards achieving the basic objective of Traditional Knowledge Digital Library (TKDL) for prevention of grant of wrong patents through

misappropriation of our traditional knowledge.

Computer-aided microscopic inspection system for medicinal plants

A computer-aided microscopic inspection system, which avoids some of the shortcomings of the conventional microscopic inspection methods, has been developed. The system, HERBAS (Herbs Authentication System) consists of a computer, microscope, digital camera, printer and custom-developed application software. The application software running on the computer allows the user to capture the microscopic images through the digital camera and utilizes them appropriately.

Excelling in scientific & industrial research output

Over 2650 basic research papers have been published in internationally peer reviewed journals with average impact factor per paper of nearly 1.90. CSIR was granted 237 patents abroad. The 60% share in the total US Patents granted to Indians, excluding NRIs and foreign assignees, belongs to CSIR.

Other CSIR’s scientific breakthroughs involves research from CCMB involving determining “Role of cyclin E in cell fate in the central nervous system of *Drosophila melanogaster*, that has led to understanding the mechanism of critical role of cyclin E in the nerve cell fate determination which will help in gene therapy for neural disorders; IICB study - “Micronuclei as Biomarkers of Carcinogen exposure in populations exposed to arsenic through drinking water in West Bengal, India: A comparative study in three cell types”; and Study from ITRC – “Modulation of P-glycoprotein - mediated multidrug resistance in K562 leukemic cells by indole-3-carbinol”.

3. S&T CONTRIBUTIONS

CSIR has several programmes relating to water, energy, environment and health care. Results of a few of the more significant, researches, are presented sectorally.

3.1 Aerospace Science & Technology

National Aerospace Laboratory (NAL) is a major player in India's aerospace programmes. The laboratory has following significant achievements.

Computational Fluid Dynamics (CFD)

NAL, using Computational Fluid Dynamics (CFD) approach, analysed practical flow situations. Some packages were also enhanced to compute real life flow situation like separated flows, flow over wings at large incidence, computation of unsteady flow over a helicopter rotor blade in hover and RANS simulation of flow past bow mounted sonar dome of a warship.

Co-Cured Co-bonded Composite Fabrication Technology

NAL has developed co-cured, co-bonded technology for fabrication of composite aircraft structures. This technology reduces the space inventory, reduces down time during maintenance and ensures a higher degree of reliability.

Supersonic Combustor / Scramjet

NAL has successfully demonstrated combustion in supersonic flow regimes using both hydrogen and kerosene in the dual mode i.e. subsonic as well as supersonic flows. The technology is very useful for futuristic propulsion systems.

Smart Materials

NAL has been working on a number of aspects relating to smart materials and their

application to aerospace systems. Technology for embedding fibre optic sensors in composite aircraft structures has been developed and demonstrated. Simultaneously, methodologies for sensor characterisation and interpretation of data provided by these sensors for detection of damage has been developed. Another notable advance has been the application of smart materials for active vibration control using Lead Zirconate Titanate (PZT) technology. A "V-stack" actuator has been developed to enhance the flutter characteristics of a control surface.

3.2 Biology & Biotechnology

CSIR continues to make wide ranging contributions in the areas of genomics, control of gene expressions, recombinant DNA products, molecular & cellular biology, tissue culture, agro-biotechnology and fermentation.

NETWORK PROJECTS

Exploration and Exploitation of Microbial Wealth of India for novel compounds and biotransformation process.

The project envisages to exploit microbial diversity of the country for commercial exploitation through both culture dependent and culture independent methods, with ultimate goal of exploiting it as a major source of biotechnological products and processes.

Molecular biology of selected pathogens for developing drug targets

The project envisages in depth study of molecular biology of a few pathogens for developing drug targets, namely for Mycobacterium tuberculosis, Plasmodium falciparum, Leishmania Donovan, Fungal pathogens (C. albicans and A. fumigatus), Enteric pathogens (V. cholerae, S. dysenteriae and H. pylori).

Developing Cell & Tissue Engineering

The project targets development of commercially sustainable and viable products in the field of Cell & Tissue engineering with applications in modern medicine and agriculture through new technologies for maintaining and growing cells *in vitro*, developing new types of cells and tissues for transplantation into new hosts including humans, methods for preparing commercially important compounds in cells and tissues of plant or animal origin etc.

Toxicogenomics of polymorphism in Indian population to industrial chemicals for development of biomarkers

The project aims to understand the molecular basis of toxic response, identify biomarkers for toxic exposure, and screen individuals who are genetically predisposed to differential toxic response. It will help design suitable strategies for reducing the risk of chemicals, treatment of toxic response, and adoption of preventive methods for susceptible individuals.

NON-NETWORK PROJECTS

Some of the projects in which CSIR has significant achievements are i) Sweet smelling peppermint genotype 'CIM-Madhuras' ii) Process technology for isolation of "Calliterpenone" a natural plant growth promoter from *Callicarpa macrophylla* iii) Cylin E in cell fate determination of *Drosophila melanogaster* iv) *Drosophila melanogaster* for genotoxicity assessment v) Chaperone-like activity of a lens protein vi) "Cim-Grow"- a highly effective plant growth promoter etc.

3.3 Chemical Science & Technology

CSIR impact has been most visible in the area of Chemical sciences. Some of the projects are as follows:

NETWORK PROJECTS

Catalysis and catalytic materials

It is envisaged to achieve development of novel mesoporous materials that include Nano tubes and Nano particles and evaluation in catalytic oxidations.

Developing green technologies for organic chemicals (CMM06)

The project targets development of Green processes for bioactives from medicinal plants, value-added organic chemicals from biomass and agro industrial wastes, alkylation and oxidation of aromatic compounds, fluoroorganics by chemical/electrochemical methods and novel mesoporous nanomaterials.

Globally competitive chemicals processes and products

It is aimed at development of new generation technologies for high demand chemicals that are strategically important for the country e.g novel bioactives, alternative fuels, new natural functional dyes etc.

Development of novel polymeric materials

The project aims to use sustainable raw materials for the preparation of specialty polymers such as Organic-Inorganic hybrids and nanocomposites, UV/E-beam curable coatings and adhesives, functional polymers for chiral separations, Specialty Polymers for petroleum industry, and specialty polymers from renewable resources.

NON-NETWORK PROJECTS

Polymers to remove cholesterol

National Chemical Laboratory (NCL) has designed polymers that remove cholesterol

very effectively. The special polymers were prepared by "molecular imprinting" technique, which involves creation of polymers imprinted with the exact shape of cholesterol. Cholesterol is used as a "template" and is surrounded by molecules (called monomers) that are linked up to form the molecularly imprinted polymer.

New processes for fuel Cell Membrane

NCL has developed two new processes to obtain high-purity diaminobenzide (DAB), the monomer that is used to prepare polybenzamidazole (PBI) membranes for fuel. The first process uses a non-carcinogenic raw material (nitro-bromoacetamide or NBA) and a novel, highly efficient catalyst. The second method (from dichlorobenzidine or DCB) involves a three-step process with a novel catalyst called titanium superoxide. Both the processes yield highly pure DAB (100 per cent purity) with no by-products.

Tunable single electron transport in nanoparticle assembly

An easy method has been developed to organize gold-MPCs at a fixed distance on SAM modified gold substrate, where the distance could be controlled by changing the length of the SAM forming molecule. The I-V measurements have done in air at room temperature by using mercury based junction and these results are useful for constructing future electronic devices.

Monolayer cathodes for Lithium Batteries

NCL has demonstrated that a cathode prepared from a single layer of molecules can be used for high-energy rechargeable lithium batteries. It could reduce the weight of the battery drastically.

Oxidative desulphurization of diesel

Indian Institute of Petroleum (IIP) has developed oxidative desulphurization method

for the removal of 4-methyldibenzothiophene (4-MDBT) and 4,6-dimethyldibenzothiophene (4,6-DMDBT). In this process the sulphur compounds present in diesel are first oxidized to sulphones to increase their polarity and subsequently removed by extraction with polar solvent or adsorption. Refractory sulphur compounds like 4,6-dimethyldibenzothiophene and its alkylated derivatives, which are extremely difficult to hydrodesulphurize in deep hydrodesulphurization (HDS), can be easily oxidized to sulphones and removed by extraction / adsorption thereby yielding ultra low sulphur diesel with sulphur content below 10 ppm. Therefore, oxidative desulphurization has great potential to be a complementary process to traditional HDS for producing ultra low sulphur diesel (ULSD).

Biosynthesis of gold nanoprisms from lemongrass

NCL has demonstrated biological synthesis of triangular gold nanoprisms. The size and shape-dependent properties of metal nanoparticles are known to have important applications in catalysis (conversion of carbon monoxide to carbon dioxide), biosensing (novel labels for DNA diagnostics), and high-density recording media.

New corrosion control belts for reinforced concrete bridges and structures

For corrosion control in salt damaged reinforced concrete bridges and structures, the only foolproof technique, till now, is cathodic protection, which is both expensive and laborious. CECRI has developed a new, simple and cost effective sacrificial protection system based on a novel proton conductive polymer back (PCPS) fill which is first of this kind in India. This back fill is capable of effectively distributing the current from a strip anode across the high resistance concrete medium and ensuring the minimum potential

shift on embedded steel reinforcements needed for satisfactory cathodic protection.

Polysaccharide based soft capsules

CSMCRI has developed a method for preparation of polysaccharide based soft capsules from inexpensive kappa carrageenan as a seaweed polysaccharide in preparation of tough, biodegradable films. The films can be recycled and reprocessed if required.

3.4 Earth Resources & Natural Hazards Assessment

Two CSIR laboratories NGRI and NIO are exclusively devoted to R&D for earth resources.

NETWORK PROJECTS

Development of techniques and methodologies for exploration, assessment and management of ground water

The project interalie aims at development of techniques and methodologies, and integration of the available advanced geophysical and hydrogeochemical data to thoroughly investigate various aquifer systems in hard rocks, characterization of the fractured and Island aquifer systems and development of techniques to simulate the process of artificial recharge and test their effectiveness for a value added groundwater management in hard rocks.

Tectonic and oceanic processes along Indian Ridge System and back arc basins

The project proposes to concentrate on Carlsberg ridge (CR), Central Indian Ridge (CIR) and Andaman back arc spreading system to understand the tectonic and oceanic processes that are occurring at these dynamic plate boundaries.

NON-NETWORK PROECTS

Gravity anomalies of a 2.5D faulted bed

An inversion technique coupled with the relevant computer code based on the Marquardt algorithm is developed by NGRI to interpret the gravity anomalies of a 2.5D faulted bed in which the density contrast varies with depth. The inversion is capable of estimating shape parameters of a 2.5D-faulted bed in addition to regional gravity background.

Determination of depths to the bottom of a 2.5-D sedimentary basin

NGRI has developed an algorithm and a code GRA2P5MOD to determine the depths to the bottom of a 2.5-D sedimentary basin in which the density contrast varies parabolically with depth. This algorithm estimates initial depths of a sedimentary basin automatically and modifies thereafter appropriately within the permissible limits.

Sudden changes in desert water - level for earthquake prediction

Significant changes in water levels of shallow and deep bore wells before and after earthquake events were observed in the Thar Desert of India and reported for the first time by NGRI. Analysis shows the water level changes directly proportional to the magnitude distance ratio (magnitude / epicentral distance) and inversely proportional to the epicentral distance. The fall in water levels was associated with global events in some cases and signifies the sensitivity of the site in arid conditions for earthquake precursory studies.

Culturable fungi in a deep-sea sediment core from the Chagos Trench, Indian Ocean

NIO has obtained paleobes, for the first time, from a deep-sea sediment core from a depth of 5904 m from the Chagos trench in the Indian Ocean. Culturable fungi, direct counts of bacteria, age of the sediments based on the radiolarian assemblage, total organic carbon, Eh and CaCO₃ were determined in these sediments.

Xylanases of marine fungi for potential use in biobleaching of paper pulp

NIO has screened obligate and facultative marine fungi for xylanase activity. The crude enzyme from NIOCC isolate 3 (*Aspergillus niger*), with high xylanase activity, effluents-free and unique properties containing 580 U l^{sup(-1)} xylanase, could bring about bleaching of sugarcane bagasse pulp by a 60 min treatment at 55°C, resulting in a decrease of ten kappa numbers and a 30% reduction in consumption of chlorine during bleaching.

3.5 Ecology & Environment

CSIR has been a major contributor in providing S&T inputs to evolve national policies and to ameliorate environmental problems.

NETWORK PROJECTS

Pollution monitoring, mitigation systems and devices with applications to environmental assimilative capacity in select regions

The project envisages development of innovative sensors, indicators and instruments for pollution monitoring and study of assimilative capacity of environmental media for pollution mitigation.

NON-NETWORK PROJECTS

Arsenic and Iron Remover from ground water by ceramic micro filtration membrane.

CGCRI has developed microfiltration system, which is a novel approach for decontamination of arsenic and iron from groundwater and to cater to the need of safe drinking water for community use. The basic components of this hybrid system are i) absorption of arsenic by the colloidal media particles suspended in water and ii) application of membrane based separation technique for solid liquid separation using ceramic microfiltration membrane module.

Photocatalytic materials for environmental applications

NEERI has developed new photocatalytic materials by doping TiO₂ with nitrogen, fluorine and transition metal compounds and also by incorporating other chemical species to achieve the visible and ultraviolet (UV) photocatalytic activity and better photocatalytic properties with respect to delayed photogenerated electron recombinations and their stability.

Building Bricks from Oil Field Effluent Treatment Plant (ETP) Sludge

The ETP of Lakwa oil field generates about 12m³ sludge per day. The sludge often contains 7-10% hydrocarbon (permissible limit is 3% for safe disposal by land filling) and is environmentally hazardous. RRL, Jorhat has developed a process for preparing value-added product like common masonry building bricks utilizing the hazardous wastes that has been employed for brick production under field condition in brick fields. Bricks prepared, replacing about 30% of the raw materials by the sludge conform to Indian

standard specification for common burnt clay building bricks.

3.6 Electronics & Instrumentation

CSIR laboratories have helped in the development of professional electronics industry in the country through development of specialized products, such as Ion-sensitive field effect transistor (ISFETs), Optical Fibre Amplifier etc.

NETWORK PROJECTS

Beam stick of micro-TWT for microwave power modules (MPM)

CEERI has designed electron gun and input and output couplers for a broadband Micro-TWT for the MPM using available computer software E-Gun and HFSS. Design of Periodical Permanent Magnet (PPM) system has also been completed using in-house developed software package MGFLD. Electron beam transmission has been simulated for the full length of the tube. In-house developed software was validated with the experimental value and the accuracy was within 5%.

Optical fibre amplifier

For the first time in India an Optical amplifier for light wave telecommunication network has been developed particularly using erbium-doped optical fibre (EDF) and power semiconductor pump laser source. The amplifier gain block with all necessary logic control and computer interface commensurate with CATV and Telecom standards has been designed and developed with an industrial partner, NeST, Cochin. This device is very much helpful in the propagation of “Fibre to Home” technology in the country.

ISFET based glucose biosensor

This biosensor comprises an ion-sensitive field-effect transistor (ISFET), which is a metal-oxide-semiconductor field-effect transistor (MOSFET) with the metal gate replaced by a chemical membrane ($\text{SiO}_2\text{-Si}_3\text{N}_4$) responsive to hydrogen ions, producing a solid-state pH-micro-sensor. The ISFET-based biosensor combines the advantages of specificity of biological systems with those offered by solid-state technology such as low cost, minimal sample preparation, high input impedance and low output impedance, and inexpensive mass production using IC technology.

ISFET pH sensor

The N-channel ion-sensitive field-effect transistor with silicon nitride sensing layer developed. This solid-state device has many advantages over the conventional glass electrode pH sensor such as micro size, robustness, easy cleaning, minimal need for maintenance, and fast response. The device has been operated in the active mode by applying a gate-source voltage through Ag/AgCl reference electrode with appropriate biasing conditions. Its pH response has been determined by three-point calibration in standard pH 4, 7 and 10 buffer solutions.

NON-NETWORK PROJECTS

“Voice Chip” for text-to-speech synthesis of Hindi language

CEERI has developed a ‘Voice Chip’, which is an Application Specific Instruction-set Processor (ASIP) based on Klatt’s parametric formant algorithm for Hindi text-to-speech synthesis. It has the potential for use in embedded systems and appliances for visually-challenged and speech-challenged persons.

Electro-Optical System for Sorting, Grading and Packaging of Apples

The opto-mechanical assembly of the illumination chamber incorporating multiple fiber cold light sources with diffusers operated with DC power supplies to provide intense uniform illumination throughout the field of view of 600 mm (H) containing four apples has been successfully completed. Experiments have been conducted on spectral characteristics for different external defects like bruises and cuts in apples.

Artificial Knee

Development of hydraulically operated artificial knee joint with rotary vane system, damping system and hydraulic chamber has been completed. Preliminary performance evaluation of the engineered prototype has been undertaken.

Functional Electrical Stimulation System

The laboratory prototype of programmable functional electrical stimulation system has been developed. In order to assess its technical feasibility for sitting-standing functions, preliminary clinical trials have been conducted on a paraplegic at Government Medical College & Hospital (GMCH), Chandigarh.

Seismic Alert System to Avert Colossal Losses during the Occurrence of Major Earthquakes

Lab testing of one Strong Motion Recorder has been completed. Algorithm and software for estimation of magnitude of earthquake has been developed. Testing is in progress with real seismic event. Lab testing of engineering model of Weak Motion Recorder has been completed. Three Field Stations have been finalized and are ready for installation.

Instrumentation for Monitoring, Detection and Early Warning of Landslides

Data Acquisition System based on PC architecture has been developed for acquiring/logging data of various geotechnical sensors required for monitoring the landslide. Inclinator, tilt-meter, crack-meter and extensometer sensors have been successfully interfaced with Data Acquisition System along with required signal conditioning. Necessary communication link has been completed. Necessary software modules for the sensors have been developed.

3.7 Energy

CSIR has been working on developing new approaches to coal fines beneficiation and recovery from the washeries, design of mini flotation plants etc.

NON-NETWORK PROJECTS

Flyash based mine support

CMRI has developed a flyash based mine support as a suitable substitute for timber prop. Other constituents of this prop are a resin and a fibre, which have been used as binding material and reinforcing material respectively. This prop is light in weight, cost-effective and bears good compressive as well as tensile strength. Talcher flyash has emerged as the most suitable for making prop.

Direct sourcing of coal for value added chemicals

CFRI has studied solubilization of two low rank bituminous coals in aqueous organic solvents. The experimental results reveal that introduction of nitro group substantially enhanced the solubilization of coal in aqueous organic solvents.

3.8 Food & Food Processing

NETWORK PROJECTS

Establishment of Genetically Modified Food referral Facility

It is imperative for the Government to have testing or referral centers in place with well-developed robust methods to accurately quantitate Genetically Modified Organisms (GMOs) in foods and food ingredients to assure compliance with threshold levels of GM products and evaluate their safety. The project aims to establish a referral center for food and food products, which will boost export of these items based on their declared absence or presence of the GM component.

NON-NETWORK PROJECTS

Protection of integrity of erythrocytes by dietary hypolipidemic spices

CFTRI has found that in rats rendered hypercholesterolemic, inclusion of spice principles - curcumin (0.2%) or capsaicin (0.015%) or the spice – garlic powder (2.0%) in the diet, produced a significant hypolipidemic effect. In addition, these dietary spices countered the altered lipid profile of erythrocyte membranes in hypercholesterolemic situation by producing a significant (10-14%) decrease in membrane cholesterol content.

Isolation and characterization of antioxidant and anticancer polysaccharides from swallow root, black cumin and belesoppu

CFTRI has prepared Pectic polysaccharides (PPS) from dietary sources such as *Decalepis hamiltonii* - Swallow Root (SRPP), *Nigella sativa* - Black cumin (BCPP), *Andrographis serpyllifolia* - Bele soppu (APP), *Zingiber officinale* -Ginger (GPP) and compared with that of citrus pectin (CPP) - reported to be an

effective antimetastatic polysaccharide even in clinical trials. PPS have been examined for their inhibitory property against Galectin-3 of HeLa cells induced agglutination of RBC.

Specific food additives for enhancing sensory quality of selected market products

CFTRI has developed an instant mix formulation, containing selected additives, for the preparation of blackgram vada. Oil content of dough based deep fat fried snacks could be decreased by the addition of enzyme treated starches. Enzymatically modified starches were found to considerably lower the fat content of Samosa without affecting the sensory quality. An instant mix formulation containing selected additives was developed for the preparation of dough based fried snacks such as Samosa / Kachori / Karjikai. Expanded rice flour and thermally processed Semolina were found to be an effective additive in the formulation of instant mix for fried snacks containing sorghum and blackgram.

PCR-based detection of 'Genetically-modified' foods

CFTRI has developed a PCR-based method for the detection of genetically modified foods, by amplification of the 'incorporated genes' viz. 35S promoter of 'cauliflower mosaic virus, NOS terminator and modified EPSPS gene. Amplification of genes for lectin and starch synthase were used as house-keeping genes for soya and maize respectively. To validate the detection method, samples of processed food products were tested for the GM-genes.

Auto analyzer for immunoassay of pesticides

Auto analyzer employs 8952 microcontroller to control the flow of reagents, samples, substrate and conjugates used for analysis. With the sequence and flow control of buffers

used, it also provides the option for reuse of the immobilized antibody column. The system has been tested for analysis of organophosphate pesticide methyl parathion and has yielded good results.

3.9 Health Care, Drugs & Pharmaceuticals

NETWORK PROJECT

DNA Fingerprinting

The main purpose of the DNA fingerprinting is the development of molecular markers for their identification and protection of medicinal plants. DNA fingerprints for plant materials of 8 different species were developed in case of *Asparagus racemosus* and two accessions in case of *Allium sativum*, namely ASFP-LVS-1 and ASFP-LVS-2. DNA from leaf tissue of these plants were isolated from green young leaves using CTAB method.

NON-NETWORK PROJECTS

Tuberculosis: Test systems and screening of new antituberculosis agents

To facilitate in vitro screening, models using nonpathogenic *M. bovis* BCG, *M. tuberculosis* H37Ra, *M. aurum* and virulent *M. tuberculosis* H37Rv as test strains expressing firefly luciferase and green fluorescent protein as reporters have been developed and adapted to throughput screening along with the Alamar Blue assay for cell viability. Assays against select defined targets viz., *M. tuberculosis* *ahpC* (target for isoniazid resistance), alpha crystalline (target for latency), isocitrate dehydrogenase available in HTS laboratory have been used for screening of their inhibitors. In addition, new assays for isocitrate lyase (targets for latency) and flavin dehydrogenase (in vivo expressed protein) have been developed for induction in

throughput screening. An experimental murine infection model has been developed and is currently being validated for drug screening. The new drug candidate is expected to be active against persistent bacteria shorten the treatment period with complete sterilization. Secondary in vitro screening of potential molecules against virulent strain of *M. tuberculosis* (H₃₇Rv) in the non-HTS mode has to selection of molecules, active at 3µg/ml or lesser doses. These molecules have been subjected to in vitro cytotoxicity assays using VERO cells. Six CDRI molecules found active have been selected for further development. Herbal extracts of a species active against *M. tuberculosis* have been identified for further development and an international patent has been filed.

Herbal medicament (HM) for treatment of stroke

CDRI has developed a Herbal medicament (HM) for treatment of cerebral stroke. The HM at the dose of 250 mg/kg provided significant protection in ischemic stroke model, and a dose of 500 mg/kg was effective upto 80%. The HM not only reduced the area of infarction but also reduced edema owing to its anti-inflammatory action.

Antiresorbing agents

CDRI has identified a novel antiosteoporosis agent on the basis of inhibition in parathyroid hormone (PTH)-induced resorption of ⁴⁵Ca from pre-labelled chick fatal bones in vitro. It prevents ovariectomy induced decrease in bone marrow density (BMD) and mineral content in ovariectomized adult as well as retired breeder female rats. In addition to being a better antiosteoporosis agent than raloxifene, it is also devoid of any estrogen agonistic activity at uterine/endometrial level. This highly cost-effective, easy to synthesize

molecule was devoid of any cytotoxicity and target organ damage and was found to be stable when stored at temperatures up to 60°C.

A biomarker for the diagnosis of visceral leishmaniasis

In search of a novel biomarker, IICB has identified the increased presence of disease specific biomarker (glycotype) on erythrocytes of patients with visceral leishmaniasis. The over expression of this biomarker have helped in the development of erythrocyte binding assay to monitor the clinical status of VL patients, which can detect VL even under field conditions. The assay can successfully diagnose VL. The assay is cheap, non-invasive, rapid and can be carried out in field conditions. It has greater sensitivity and minimal cross reactivity with malaria and tuberculosis. The potentiality of this discovery has been quickly identified by World Health Organisation (WHO) for its global application and the technology has recently been transferred to an Indian company (Zephyr Biomedical, Goa)

Curcumin (Haldi) in prevention of indomethacin-induced gastric ulcer

IICB has studied the regulation of MMP-9 and MMP-2 activities in indomethacin-induced acute gastric ulceration and healing. Indomethacin ulcerated stomach extracts exhibit significant upregulation of pro MMP-9 (92 kDa) activity and moderate reduction of MMP-2 activity, which strongly correlate with indomethacin dose and severity of ulcer. The results show that curcumin exhibits potent antiulcer activity in acute ulcer in rat model by preventing glutathione depletion, lipid peroxidation and protein oxidation. Denudation of epithelial cells during damage of gastric lumen is reversed by curcumin through re-epithelialization. Furthermore, both oral and intraperitoneal administration of

curcumin blocks gastric ulceration in a dose dependent manner. It accelerates the healing process and protects gastric ulcer through attenuation of MMP-9 activity and amelioration of MMP-2 activity.

Genetic polymorphism in selected genes and their role in Parkinson's disease

ITRC has studied Parkinson's disease (PD), wherein a case-control study of, the frequency and association of functionally important polymorphism in the genes such as the cytochrome P450 2D6 (CYP2D6), monoamine oxidase B (MAO-B), dopamine receptor-2 (DRD2) and glutathione S-transferase-theta (GST-T) was investigated, using allele-specific PCR and RFLP assays.

Recombinant Oral Vaccine for Cholera

The vaccine, first of its kind anywhere in the world outside USA was constructed by IMT following a novel strategy in which an avirulent strain was converted into a vaccine candidate capable of elaborating only the immunogenic B subunit of the cholera toxin using recombinant DNA technology. This candidate vaccine which has been found to give full protection in animal studies and completely safe has also been found to be completely safe toxicologically. This particular strain, a collaborative effort with the National Institute of Cholera & Enteric Diseases and IICB is undergoing phase II human trials.

3.10 Information Dissemination & Products

NETWORK PROJECTS

Comprehensive traditional knowledge digital documentation and library (TKDL)

The project envisages to prevent misappropriation of traditional knowledge that exists in public domain by creating a

database on this knowledge in five international languages that are English, German, French, Spanish and Japanese and making these available to patent examiners throughout the world to prevent bio-piracy. The codified knowledge of the country will be converted into easily accessible and retrievable patent application digital format.

Ayurveda Phase II

Images of all the multiple references of 36,000 formulations transcribed were included in the database. More than 13,500 formulations have been identified from the Ayurveda texts and they have been checked for the duplicates. Transcription of formulations has been completed for 2,700 formulations.

NON-NETWORK PROJECTS

NISCAIR is engaged in number of Non-network programmes such as Science popularization, Science and Society in the 21st Century: The Road Ahead, IT literacy programme, CSIR News, CSIR Samachar, The Wealth of India, Consultancy services programme, Indian Patent Database (INPAT) Translation services, etc.

3.11 Leather

Central Leather Research Institute (CLRI) of CSIR is the largest leather institute in the world. Some of the achievements of CLRI are highlighted below.

Contribution to environment

After 1996, Indian leather sector and particularly that of Tamil Nadu has faced major crisis on account of environmental problems. The lasting and enduring partnership of CLRI with industry has made it possible to provide meaningful solutions to the tannery sector in the state. Today all functional tanneries in the state are connected to pollution control devices. There are a total

of 14 CETPs now in leather sector in TN. They have been receiving inputs of technology for upgradation and modernization. It has emerged an ongoing partnership with traceable impact on environmental preparedness.

TDS control in leather processing

CLRI has pioneered in Total Dissolved Solids (TDS) reduction measures, which include effective desalting, hair saving, less sulfide - enzyme assisted unhairing, recycling of reliming liquor, recycling of pickle liquor. This has been implemented in two tannery clusters in Tamil Nadu viz. Dindigul and Pernambut. TDS reduction by 67%, chloride reduction by 40%, water (input) reduction by 15-20%, BOD reduction by 35% and reduction in sludge volume 20% has been feasible.

A Neem oil based preservation has been developed with shelf life of more than 5 months without putrefaction or deterioration skins can be preserved by applying on both sides.

Zero discharge tanning

CLRI has developed a process for near zero discharge wastewater by enzyme aided washing and pickling wastewater. This method has been tested at semi commercial scale in wet blue production and it has been found that the process does not render any negative effect on physical or organoleptic properties of leathers.

Product design & development

CLRI has initiated measures to develop new products and seek copyright protection as well as on contract development mode. Design outputs from CLRI have registered figures like 150 designs per year currently. There is an attempt to increase this further.

Thermal insulation studies in garments

CLRI has studied thermal insulation property in garments by measuring the heat supply after bringing equilibrium between the environment temperature and heat source temperature. It was found that among all leather types (except suede) the zipped garment has more thermal insulation than buttoned garments. Thermal insulation is found to be more in cow nappa apparels among the selected nappa and suede apparels.

3.12 Material, Minerals, Metals & Manufacturing

NON-NETWORK PROJECTS

Fullerene doped glasses

CGCRI has developed a series of fullerene C₆₀-borate glasses composites of optical quality bearing high concentration of C₆₀ and their nonlinear optical properties were studied to identify their suitability as Non-Linear Optical (NLO) materials. These composites show moderate third order nonlinear optical properties and good optical limiting properties i.e. they can limit the transmission of high intensity light and hence can serve as a protector of laser detectors.

Special fibres for writing fibre Bragg-grating (FBG)

Fibre optic Bragg grating (FBG) in different configurations have found major applications in Er-doped fibre amplifier (EDFA) and provides practical solutions for laser wavelength stabilization, pump wavelength filtering and gain flattening in multi-channel wavelength amplification for reducing problems of non-linearities encountered in optical network. CGCRI has fabricated preforms containing suitable dopants in the core in different proportions by Molecular chemical vapour deposition (MCVD) process

and fibres were drawn from the preforms with online resin coating.

Inverse melting in the Ti-Cr system

NML has presented a model of inverse melting, which states that it is the close-packed hexagonal closed packing (hcp) structure that transforms to the amorphous phase whereas the transformation of the relatively open bcc structure to the amorphous phase is forbidden thermodynamically. The phenomenon of inverse melting also offers the opportunity to produce amorphous solid by heating an ordered crystal structure.

ZnS : Mn nanoparticles

NPL has devised a unique and simple method for synthesizing ZnS:Mn nanoparticles capped in-situ by ZnO. Characterization studies show the formation of ZnO capping layer on the surface of ZnS:Mn nanoparticles. Particle size of the ZnS:Mn nanophosphor developed is about 4 nm. The samples were prepared using sol-gel technique followed by annealing at different temperatures to remove trapped fluid inside the amorphous silica cage. It has been observed that the nanocrystals grow in size and undergo phase transition from cubic to hexagonal at temperatures between 700-900°C. This is one of the first reports on hexagonal ZnS formation in nanophase.

Closed pore aluminum foam

RRL-Bhopal has synthesized aluminium alloy foam and aluminium-SiC composite foam of varying relative density (0.1-0.5) through liquid metallurgy route using thickening and foaming agent. These foam materials are very useful for shock and energy absorption. The mechanical properties of the RRL- aluminium foam are comparable to the commercially available foams with energy absorption capacity varying from 2-4J/cc.

Cost effective fibrizer hammer tips for sugar mills

Hammer tips, mostly imported, are the most essential components of a fibrizer unit of a sugar mill used for fibrizing the sugar cane. The hammer tip component (60 Nos.) of two different compositions fabricated by RRL, Bhopal are under field trial in a sugar mill for the last three months for performance evaluation. Field trial analysis indicated that the developed hammer tips are performing 1.2 times better than the conventional imported ones. The developed components would be cheaper by around 50% as compared to the conventional (imported ones) ones with improved performance thereby leading to a substantial monetary savings in view of the large volumes of consumption of the component in various sugar mills in the country.

3.13 Human Resource Development

CSIR strives to promote and foster the upgradation of the stock of qualified, highly specialised scientists/engineers and technologists in R&D in all disciplines of S&T in the country. For that an integrated approach has been developed for the national human resource development for S&T by encouraging and promoting research in the universities and institutions of higher learning. Every year CSIR gives away the prestigious Shanti Swarup Bhatnagar prizes (SSB) and CSIR Young scientist Awards (YSA). CSIR also provides financial assistance to promote research in the field of Science and Technology including agriculture, engineering and medicine. It is given in the form of research grants to Professors/ Scientists in regular employment in Universities/ Academic Institutes/ IIT's etc. The number of research schemes recommended during 2004-2005 around 160 out of 560 received. In addition, CSIR tries to

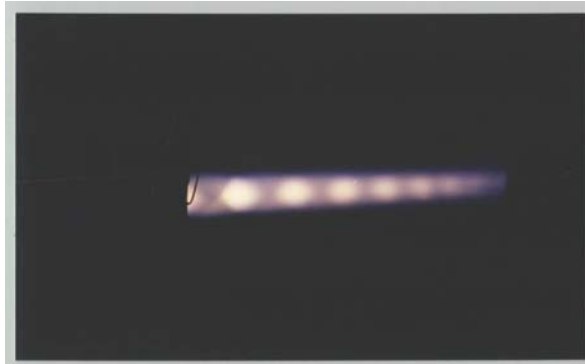
reinstate the interest of science amongst youngsters through various programmes and activities. CSIR is running various programmes to promote science. Significant ones are Enterpreunership support to research scholars, Fellowship in trans-disciplinary areas, and CSIR Programme on youth for leadership in science. Around 1000 students have participated in the two open days programme organized by most of the CSIR laboratories. CSIR also supports selective NET qualified research fellows in the form of Shyama Prasad Mukherjee Fellowship. The selection is based on written examination followed by interview of NET qualified scholars. Six candidates were selected for the fellowship, – two each in life, mathematical & physical sciences. CSIR has supported young researchers through Senior Research Fellowship, Extended Senior Research Fellowship, Associateship and Extended Research Associateship. CSIR Diamond Jubilee Research Interns Award Scheme trains young interns in the tools, techniques and art of research under the supervision of experienced scientists in CSIR.

3.14 New Millennium Indian Technology Leadership Initiative (NMITLI)

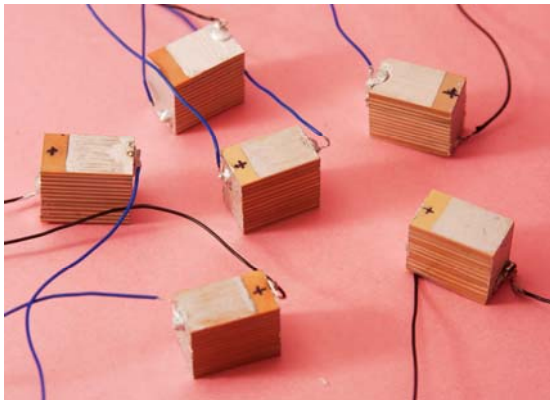
There are 37 on-going projects cover diverse areas ranging from liquid crystals to decentralized power packs; mesoscale modeling to nano-material catalysts; microbiological conversions to biotech molecules; functionalisation of alkane to advanced nano-materials and composites; defunctionalisation of carbohydrates to biodegradable plastics; novel office computing platform to low cost horizontal axis wind turbine; and new targets and markers for cancer to advanced drug delivery systems. It is one of the largest Public-Private partnership effort involving 175 groups from research institutions and 65 industrial partners.



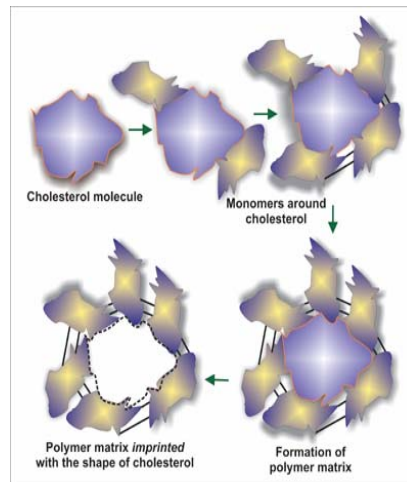
Trouser Duct for TEJAS



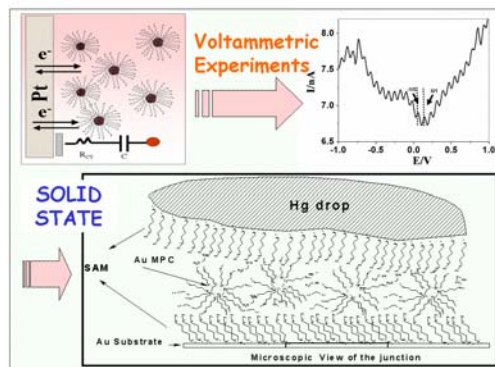
Demonstration of supersonic combustion



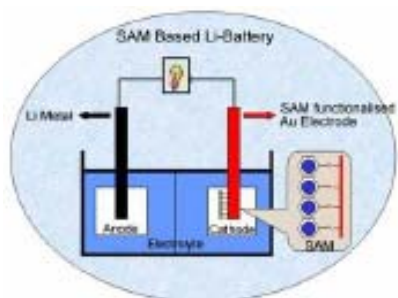
Piezo actuator stack



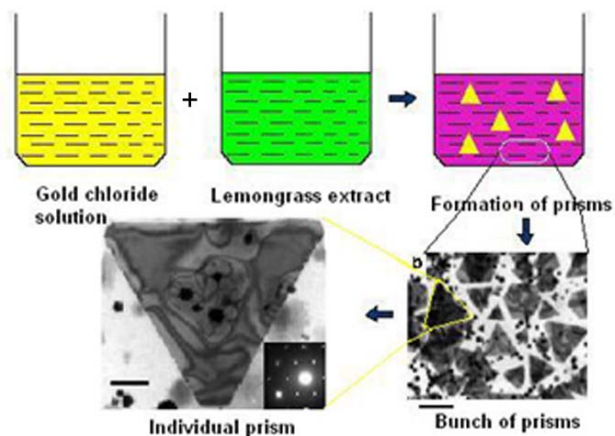
Polymers to remove cholesterol



Tunable single electron transport in nanoparticle assembly



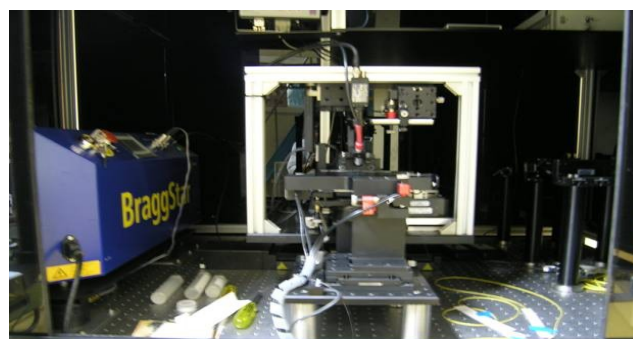
Monolayer cathodes for Lithium Batteries



Biosynthesis of gold nanoprisms from lemongrass



Ceramic Membrane module for removal of Arsenic from ground water



In-fibre Bragg grating writing set up using UV excimer laser



Sugar mill along with fibrizer fitted with the hammer tips developed at RRL, Bhopal under field trials



Cytoprotective effect of SR-Aox against oxidative stress induced cellular damage