



CSIR News

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In The News

CSIR Responds to the Uttarakhand Flood Tragedy

The June 2013 torrential rains and the consequent flash floods wrought one of the worst natural disasters in recent history in the hill state of Uttarakhand. While hundreds perished and thousands were displaced, the state recorded massive destruction of infrastructure and road and communication links.

As always, the Council of Scientific and Industrial Research (CSIR) was quick to step in with much needed help for those caught up in the disaster. While the CSIR-Central Food Technological Research Institute (CFTRI), Mysore, rushed in more than eight tonnes of shelf-stable and nutritious food materials for distribution among the victims, a 12-member team from the CSIR-Central Salt and Marine Chemicals Research Institute (CSMCR), Bhavnagar, Gujarat, landed in Uttarakhand to provide safe drinking water solutions for those affected by the tragedy.

Meanwhile, CSIR-National Chemical Laboratory (NCL), Pune rushed in water filtration units and water hand pumps, the CSIR-Institute of Minerals and Materials Technology (IMMT), Bhubaneswar sent water filters and the CSIR-Central Leather Research Institute (CLRI), Chennai provided footwear. The CSIR-Indian Institute of Petroleum (IIP), Dehradun that coordinated the



distribution and logistics in collaboration with the state disaster management team, readied 100 bags containing wheat flour, rice, pulses, salt, cooking oil, match boxes, candles, footwear, tents, rain-coats, and utensils for distribution in the hills.



CSIR Responds to Tragedy

CSIR-CSMCRI, Bhavnagar: Two RO units fitted on two trucks – one with a clean water capacity of 3000 lt/hour was placed in Rishikesh and two Hollow-fiber Ultra Filtration (UF) units – one of 1000 LPH capacity and the other of 10,000 LPH capacity – at Srinagar, Garhwal.

CSIR-CFTRI, Mysore: Mathi (60 cartons), roti (15 cartons), tomato sauce (1 carton), murmure (300 bags), energy powder (200 bags), high protein rusks (59 cartons), *bisi bele bhaath* (a kind of South Indian *khichadi* – 189 cartons), *imli poha* (56 cartons), ORS (153 carton), bread (4 cartons), rusks (4 cartons).

CSIR-NCL, Pune: Water filtration unit (20 boxes), Water hand pumps (20 boxes).

CSIR-IMMT, Bhubaneswar: Water filters (500 units).

CSIR-CLRI, Chennai: Footwear (2020 pairs)

CSIR-IIP Dehradun: Raincoats (1000 nos.), Tirpal (100 nos.), stainless steel utensil sets (200 nos.), plastic tags (200 nos.), candles (44 packets of 968 piece each), match boxes (63 packets of 900 pieces each).



A view of pilot plant where canned *bisibele bhath* was prepared

Ready-to-eat Foods from CSIR-CFTRI

Notwithstanding the logistics of reaching the relief across a distance of 2500 kilometres, CSIR-CFTRI immediately got down to the challenging task as soon as the dimensions of the tragedy unfolded. Survival rations in the form of tasty, long shelf foods such as high protein rusks and canned *bisibele bhath* (spicy sambar rice), quick preparation foods like *imli poha*, energy foods for providing nutrition post-rescue and *chapatis* to cater to immediate hunger were included in the menu.



Imli poha being packed



Prof. Ram Rajasekharan
(in the Centre) lends a hand to
upload a relief packet



Food packets stacked for uploading



Food packets being sent to
Uttarakhand

While the long-shelf foods such as high protein rusk, canned *bisibele bhath* and *imli poha* were prepared in the Institute itself, the energy food and *chapatis* that needed larger manufacturing facility were produced in the units of CSIR-CFTRI licensees closer to Uttarakhand. In fact, M/s JVS Foods Ltd., Jaipur immediately offered to reach three tonnes of energy food directly to Dehradun free of cost. Thirteen thousand tetrapaks of ORS were provided free of cost by M/s Juggat Pharma, Bangalore. The *chapatis* were made at a utility in New Delhi that had CFTRI-designed *chapati* machines.

The manufacturing that began on 27 June morning readied three tonnes of food by the evening, which was despatched to Bangalore to be airlifted to Delhi by the national carrier Air India. The national carrier offered free logistic support between Bangalore and

Delhi, reducing the transit time of the relief foods.

In about 36 hours, CSIR-CFTRI had produced more than 12,000 cans of *bisibele bhath* with more than three month shelf life, 5000 packets of rusk with 1.5 times more proteins than the usual, 12,000 packets of *imli poha* which could be reconstituted with just water in about 15 minutes and 5000 packets of Oral Rehydration Solution (ORS). The ORS was included as dehydration is one of the major post-rescue effects, caused by epidemic infections and might nullify any nutritional benefit provided by the relief foods.

The first consignment of foods reached CSIR-IIP, Dehradun on 28 June and the second consignment on 30 June 2013. More than eight tonnes of food and about two tonnes of ORS were made available by the Institute for the relief operations.

Potable Drinking Water from CSIR-CSMCRI

With the flash floods wreaking havoc in the hills, supplying potable drinking water to those trapped was also a daunting task for the administration. However, within no time CSIR-CSMCRI had set up a Reverse Osmosis (RO) mobile unit of about 3000 litre/hour capacity at Rishikesh and two Hollow-fiber Ultra Filtration (UF) units – one of 1000 LPH capacity and the other of 10,000 LPH capacity – at Srinagar, Garhwal.

The CSIR-CSMCRI teams were stationed in the region for ten days. While the team at Rishikesh served the community extensively by providing RO water tankers, the two UF plants at Veer Chandra Singh Garhwali Govt. Medical Science & Research Institute Srinagar, Garhwal served hospital patients and also the local community through tankers and from the plant sites.

The CSIR-CSMCRI teams also trained

the local people in the operation of the plant independently. In fact, impressed with the highly successful operation of the units in providing safe drinking water, the Dean/Principal of the hospital even requested the Director, CSIR-CSMCRI to retain one UF Plant.

M/s Uniquelflux Membranes, Pune, who have acquired the license for manufacturing TFC RO membrane and Hollow-fiber Ultra Filtration membranes from CSIR-CSMCRI, also set up about 25 UF-based water purification and disinfection units in the affected areas.

CSIR institutes have earlier also responded to many natural calamities like the earthquake in Gujarat, Bihar floods, Orissa cyclone, tsunami on the eastern coast and floods in West Bengal. The CSIR has now decided to set up a more efficient and permanent Disaster Response System at its institutes to respond immediately to any such unfortunate eventualities.



Distribution of treated water through tankers provided by the local administration



Water Purification through Ultra Filtration at H.N. Bahuguna Base Hospital, Srinagar, Uttarakhand



Inside view of the mobile unit



A close-up of the kit sent to Uttarakhand

DG-CSIR inaugurates Data Centre and Video Recording Studio at CSIR-NISCAIR



Prof. Samir Kumar Brahmachari inaugurating the DIRF-Data Centre

Prof. Samir Kumar Brahmachari, DG-CSIR, inaugurated a Data Information Resource Facility (DIRF) and a Video Recording Studio at the CSIR-National Institute of Science Communication and Information Resources (NISCAIR), New Delhi on 26 June 2013. He was accompanied by Dr. Gangan Prathap, Director, CSIR-NISCAIR and other personnel from the institute.

The ultra-modern and well-equipped DIRF has been created to host, manage and secure digital resources and services of CSIR-NISCAIR as well as other laboratories of CSIR. The DIRF is envisaged to provide uninterrupted, authorized and secure access (remote and local) of its digital resources, assets and services to the scientific community. It may be used for co-location of other CSIR laboratories' servers and services and also as disaster recovery site for the laboratories.

The usage of DIRF can be extended to other government departments and universities as well in the future. In the first phase, other CSIR laboratories that do not have redundant and secured IT infrastructure would be asked to co-host their prime services from DIRF. In the second phase, other government R&D Institutes will be contacted for co-location of the servers, depending upon the availability of space in the Data Centre. A revenue model for non-CSIR organizations would be evolved in due course to meet the DIRF expenditure.

The DIRF also houses a well-equipped classroom facility for training and a Software Development Laboratory for the development, testing and implementation of software and applications. Prof. Brahmachari went round the facility and appreciated the work done.

Subsequently, Prof. Brahmachari visited the Science Communication through Multimedia (SCM) Division of CSIR-NISCAIR to inaugurate the Video Recording Studio. In a country where the impact of a medium like television is very



Prof. Samir Kumar Brahmachari takes a round of the DIRF



DG-CSIR inaugurating the Video Recording Studio



Prof. Samir Kumar Brahmachari inside the Studio

The powerful combination of science communication and social media can be illustrated with the example of the recent landslides. By providing a server where people could upload photographs and videos of landslides, a wealth of information about landslides including geospatial data could be generated.

Prof. S.K. Brahmachari
DG-CSIR



DG-CSIR watching the documentary on CSIR- IHBT made by CSIR- NISCAIR

high, CSIR-NISCAIR has taken up the challenge of creating multimedia content on scientific and technological subjects. It was to give a thrust to the Institute's foray into multimedia content generation that the SCM division has been recently created.

Ever since then, the division has been equipped with the latest HD technology, a shooting floor with HD recording facility and editing bays for film quality HD editing. The division has already completed documentary

films on the CSIR-National Physical Laboratory (NPL) and the CSIR-Institute of Himalayan Bioresource Technology (IHBT). In fact, the film on CSIR-IHBT was screened for the DG-CSIR.

Inaugurating the newly constructed Video Recording Studio, Prof. Brahmachari illustrated the powerful combination of science communication and social media by giving the example of the recent landslides. He suggested that by providing a server where people could upload photographs and videos of landslides, a wealth of information about landslides including geospatial data could be generated.

Prof. Brahmachari also called for seamless integration of the print communication and multimedia communication activities of CSIR-NISCAIR with the newly created Data Information Resource Facility to cater to places in the country that lacked resources. He said that while many villages lacked classrooms, they were covered by 4G mobile infrastructure capabilities. CSIR-NISCAIR could provide science education to these villages through mobile phones.

Mega Solar Panel installed at CSIR-IIP



Prof. Samir K. Brahmachari, DG-CSIR inaugurated a 130 KW solar energy panel at the CSIR-Indian Institute of Petroleum (IIP), Dehradun on 14 June 2013. The solar panel would not only result in saving energy but also reduce the electricity bill of the institute by about ten percent.

The energy from the solar panel can help run about 500 tubelights, 150 fans and 50 computers in full capacity. The Ministry of New and Renewable Energy has provided assistance to the institute in this project. The Central Electronics Ltd. helped in the

installation and has undertaken the responsibility of its maintenance for two years.

Speaking on the occasion, Dr. M.O. Garg, Director, CSIR-IIP, hoped that the installation of this panel would enhance the efficiency of the scientists as it will provide uninterrupted supply of power and shut downs will reduce tremendously. It would also play an important role in the protection of the ecology of the CSIR-IIP campus, and would help reduce the carbon footprint by about 153.738 tonnes per year.

R&D Highlights

Rapid Dissolution of DNA in a Novel Bio-based Ionic Liquid

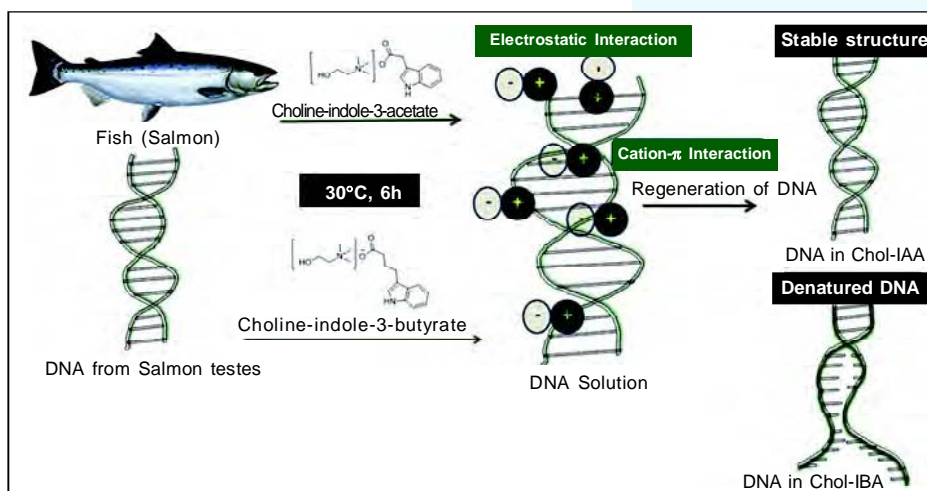
Deoxyribonucleic acid (DNA) is a molecule that encodes the genetic instructions used in the development and functioning of all known living organisms and many viruses. Recent research has recognized DNA molecules as useful building materials in various fields. Some of its properties such as its nanoscale structural distribution, molecular recognition properties, etc. make it an interesting candidate for designing novel nano and advanced materials. Recently, DNA polymer hybrid materials have been designed for applications such as bioanalysis, biomedicine and stimuli-responsive materials.

DNA is a very delicate molecule and is considered structurally stable in aqueous medium but conditions like harsh temperature and pH, ionic strength, etc. can disrupt the DNA helical geometry and result in its denaturation. The molecule is found to lose structural integrity in organic solvents such as dimethyl sulphoxide, formamide, methanol etc. Successful dissolution of the molecule in an ionic liquid (IL) named ethylimidazolium tetrafluoro

borate opened up a new area to use this molecule as biomaterial in an ionic media.

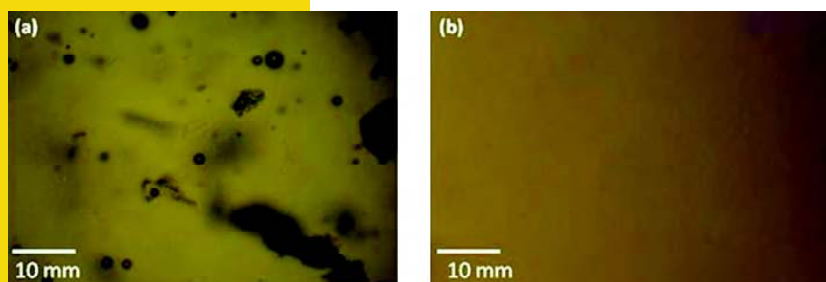
Although there are a few research papers on the dissolution of DNA in a few ILs, the main disadvantage is the low solubility of the molecule in the ILs and very lengthy dissolution time (3 to 4 weeks), which restricts the application of the molecule in certain fields.

DNA from salmon testes was dissolved in two new types of bio-based ionic liquids

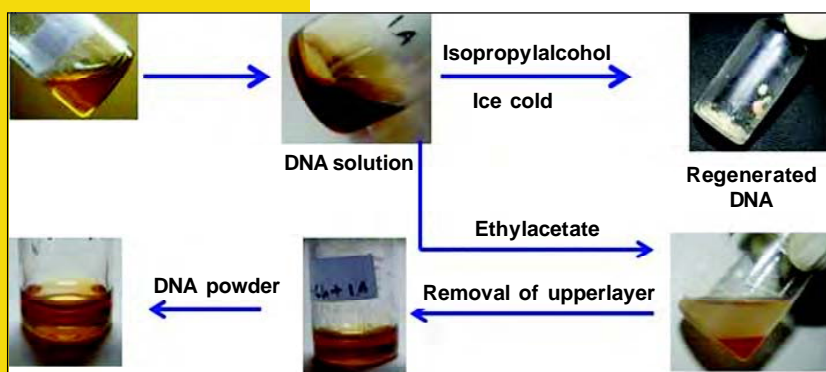


Dissolution of DNA (from Salmon testes) in choline-indole-3-acetate (chol-IAA) and choline-indole-3-butyrate (chol-IBA) (Salmon photograph was taken from www.ontariofishspecies.com)

(choline-indole-3-acetate (chol-IAA) and choline-indole-3-butyrate (chol-IBA)) at concentrations up to 3.5% *w/w* in 6 hours. Phase contrast microscopic imaging of the DNA solution in both the ILs did not show presence of any insoluble particles, whereas the presence of insoluble particles was clearly visible in the solution before dissolution. The ionic liquids used were recycled after recovering DNA and successfully reused for three consecutive cycles for redissolution of fresh DNA samples without compromising the structural integrity of the latter.



Phase contrast microscopic image of DNA in chol-IAA (a) before dissolution and (b) after dissolution



Pictorial demonstration for the dissolution of DNA in chol-IAA, recycling and subsequent reuse of the ionic liquid

The regenerated DNA from both the ionic liquids was characterized in order to study the chemical and structural stability of the molecule upon dissolution in the bio-ILs both just after dissolution and after storage in the IL at room temperature for six months using various analytical techniques.

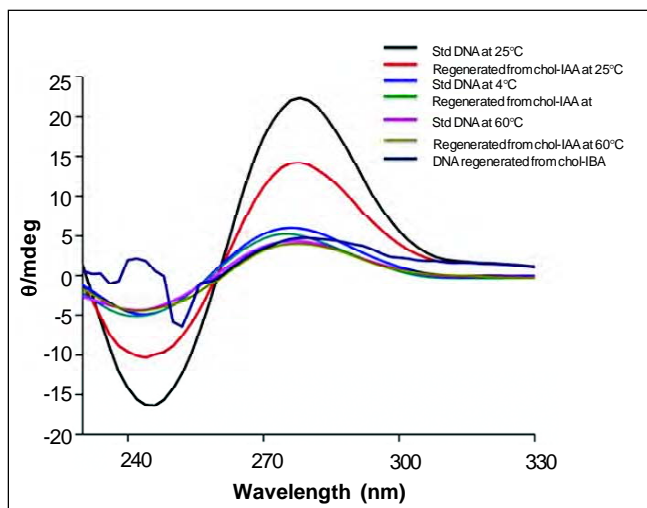
The regenerated DNA from chol-IAA and standard DNA in Tris-HCl buffer showed similar UV-Vis absorption patterns with ratio of absorbance at 260 to 280 nm

being 1.89 for the regenerated DNA, where the ratio was 1.92 for the standard DNA indicating no denaturation of the molecule in the ionic liquid during dissolution. However, the regenerated DNA from chol-IBA showed different absorption patterns with absorption maxima shifted towards higher wave length indicating denaturation of the molecule in the ionic liquid.

Furthermore, after six months of storage of the DNA in chol-IAA at room temperature, the regenerated DNA from the IL in Tris-HCl buffer showed similar UV-Vis absorption pattern to that with standard DNA. However the DNA stored in Tris-HCl buffer for the same time period at room temperature was found to be degraded. Characteristic B form of DNA in the regenerated DNA from the IL was also visible in the Circular Dichroism spectra (CD).

To understand the change of the secondary structure of DNA due to dissolution at low and high temperatures, the CD spectra of standard DNA in tris-HCl buffer at 4° and 60°C and regenerated DNA from chol-IAA and chol-IBA were recorded. The CD spectrum of standard DNA at 25°C showed a long wave positive band at 278 nm corresponding to π - π base packing and a short wave negative band at 243 nm corresponding to helicity.

The peak to trough ratio at this temperature was 0.36, while the magnitudes of positive and negative peaks became almost equal at 4° and 60°C characteristics of B-form of DNA. The regenerated DNA from chol-IAA also showed characteristic peaks similar to standard DNA and at 25°C the peak to trough ratio was 0.33 similar to standard DNA indicating preservation of structural integrity of the molecule during dissolution in chol-IAA. No changes in the positive and negative peaks of the regenerate DNA were observed at 4° and 60°C indicating presence of B-form in the moiety. These results clearly demonstrated the structural and chemical stability of the DNA molecule during dissolution in chol-IAA. On the other hand, the regenerated DNA from chol-IBA showed



Circular dichroism spectra of standard DNA and regenerated DNA from chol-IAA and chol-IBA at three different temperatures in tris-HCl buffer

distorted peak signature of degradation of the molecule.

In phosphorus-31-NMR spectroscopy, the chemical shift of the normal phosphate group of standard DNA was observed at -1.215 ppm and that of regenerated DNA was observed at -1.669 ppm, almost similar to that with standard DNA indicating intact chemical structure of DNA during dissolution in chol-IAA. On the other hand, the regenerated DNA from chol-IBA showed distorted signal for the normal phosphate groups indicating damage in the DNA structure. It is known for DNA solubilized in 1-butyl-3-methylimidazolium chloride (BmimCl) that, the molecular interaction between the ionic liquid and DNA

takes place via strong electrostatic interactions between the cationic head group Bmim⁺ and phosphate groups of DNA and the hydrophobic association takes place between aliphatic chain of IL and the DNA bases.

Similar electrostatic interactions as well as cation- π interactions among choline and phosphate as well as DNA bases made the molecule soluble in chol-IAA. In the case of chol-IBA, although the above interactions made the molecule to solubilise in the IL, perhaps the geometry of IBA

did not favour the chemical and structural stability of DNA.

Achieving high solubility for DNA in a bio-based ionic liquid with long-term structural and chemical stability will help to facilitate sustainable processing and effective chemical derivatization of the promising biopolymer.

Published paper citation:

Mukesh, Chandrakant; Mondal, Dibyendu; Sharma, Mukesh and Prasad, Kamalesh. Rapid dissolution of DNA in a novel bio-based ionic liquid. *Chem. Commun.*, 2013, **49**, 6849-6851

Summarized by Kamalesh Prasad at CSIR-CSMCRI

CSIR-IHBT develops New Cultivars of Ornamental Rose

Rose is universally acclaimed as the “queen of flowers”. The plant has a wide range of adaptability to various soil and climatic conditions. It has a long blooming period and its flowers are beautiful with good shelf life. However, the presence of thorns in the plant is considered an undesirable trait.

Research at CSIR-Institute of Himalayan Bioresource Technology (IHBT) has now led to the development of a unique thornless rose cultivar. A thornless ‘bud sport’

ornamental rose was selected naturally from plants of First Red having thorns. The performance of the thornless ‘bud sport’, named *Himalayan Wonder*, was evaluated under polyhouse conditions. The flower colour is classified as Red Purple as per the Royal Horticulture Society colour chart.

Another ‘bud sport’ ornamental rose was selected naturally from plants of First Red and named *Himalayan Glory*. The performance was evaluated under polyhouse

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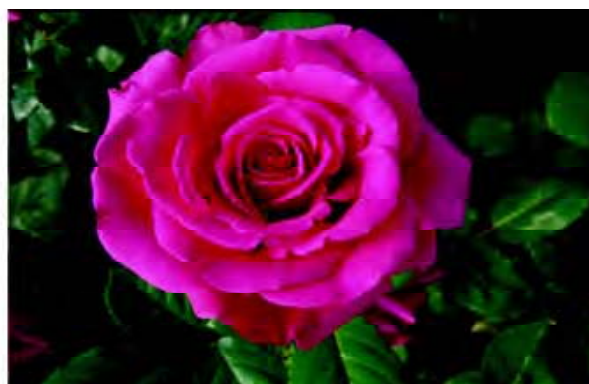
CSIR-IHBT's Cultivar *Himalayan Wonder*

Salient Features of the Cultivar *Himalayan Wonder*

1. Length of flowering shoot (cm)	78.46
2. Diameter of flowering shoot (cm)	0.710
3. Diameter of flower bud (cm)	2.59
4. Length of flower bud (cm)	4.51
5. Diameter of bud neck (cm)	0.517
6. No. of flowering shoot per plant/year	26.60
7. No. of flowering shoot/m ² net area/year	213
8. Size of fully open flower (cm)	10.23
9. No. of petals per flower bud	31.40
10. Colour of stem/shoot	Green
11. Colour of upper surface of leaves	Green
12. Colour of lower surface of leaves	Green
13. Outer colour of petal	Red Purple
14. Inner colour of petal	Red Purple
15. Vase life (days)	7

Salient Features of the Cultivar *Himalayan Glory*

1. Length of flowering shoot (cm)	62.76
2. Diameter of flowering shoot (cm)	0.625
3. Diameter of flower bud (cm)	2.71
4. Length of flower bud (cm)	4.51
5. Diameter of bud neck (cm)	0.486
6. No. of flowering shoot per plant/year	26.94
7. No. of flowering shoot/m ² net area/year	215
8. Size of fully open flower (cm)	10.65
9. No. of petals per flower bud	31.58
10. Colour of stem/shoot	Green
11. Colour of upper surface of leaves	Yellow Green
12. Colour of lower surface of leaves	Yellow Green
13. Outer colour of petal	Tyrian Purple
14. Inner colour of petal	Tyrian Purple
15. Vase life (days)	8



CSIR-IHBT 's Cultivar *Himalayan Glory*

conditions. The flower colour of this 'bud sport' was Tyrian Purple as per the Royal Horticulture Society (RHS) colour chart

The two new rose cultivars, *Himalayan Wonder* and *Himalayan Glory*, developed through intensive selection at CSIR-IHBT, were analyzed for microsatellite

polymorphisms. The cultivar *Himalayan Glory* recorded high genetic affinity with *First Red*, while *Himalayan Wonder* confirmed moderately high divergence. Further, newly developed cultivars, namely, *Himalayan Wonder* and *Himalayan Glory* recorded 53% genetic diversity with each other.

Plasma Sprayable Ceramic Powders and Coatings for Functional Applications



Thermal spraying has emerged as an increasingly sophisticated surface engineering technology. It is an efficient, economical, and environment-friendly method of applying coatings for a wide range of industrial applications.

Thermal spraying techniques are coating processes in which a heated material is sprayed onto a surface. In the process it marries two dissimilar materials to improve, in a synergistic way, the performance of the whole. Thermal spraying offers a wide choice of materials and processes that have a reduced impact on the environment when compared to conventional plating processes.

The thermal spray industry in India continues to grow and diversify; the industry initially served markets such as pulp and paper, steel and mining and now has expanded to include automotive, aerospace, nuclear, power and medical sectors. Researchers have found thermal spraying, especially Air Plasma Spraying (APS), to be a low cost technique compared to other techniques like Electron Beam Physical Vapour Deposition (EB-PVD), sputtering etc.

In plasma spray process, the material to be deposited is typically in the form of a powder, and sometimes as a liquid; suspension or wire is introduced into the plasma jet, emanating from a plasma torch. Plasma spraying process is also rapid and easy for automation, making the process potentially very well suited for mass production. There are an ever increasing number of technical applications of plasma sprayed coatings.

APS is a well established and versatile technique for imparting functional properties to coatings for application in energy, aerospace, automotive, bio-medical and industrial sectors. Most of the coatings, in addition to functional properties will impart wear and corrosion resistance to the coated components.

Plasma sprayable powders and plasma spray parameters play a pivotal role in determining the properties of the coatings.

Plasma spray technology requires powders with good flowability and large particle size (20-100 μm) as individual particles cannot be thermally sprayed because of their low mass and the resultant inability to be carried in a moving gas stream and deposited on a substrate. Specialized powders for a variety of industrial applications are being produced by spray drying, fluidized bed sintering, agglomeration, fusing/melting, plasma spheroidizing, atomizing, and sol-gel processes. Most of the methods reported in the literature employ an additional agglomeration step to get plasma sprayable powders and thus are more expensive and laborious. The agglomeration processes include pelletizing, pressing or spray drying.

The thermal spray community in India continues to expand through its coating shops, research centers and in-house dedicated coating and finishing operations. However, the industry imports much of its feedstock, wire, rod, equipment and spare parts. At CSIR-NAL, our research initiatives are focused towards the indigenous preparation of plasma sprayable oxide powders via simple chemical routes and fabrication of coatings that can find applications in energy, aerospace, engineering and biomedical applications. The indigenously developed powders have been successfully plasma sprayed using a high power (80 kW) APS system procured under the CSIR-NMITLI project in 2005.

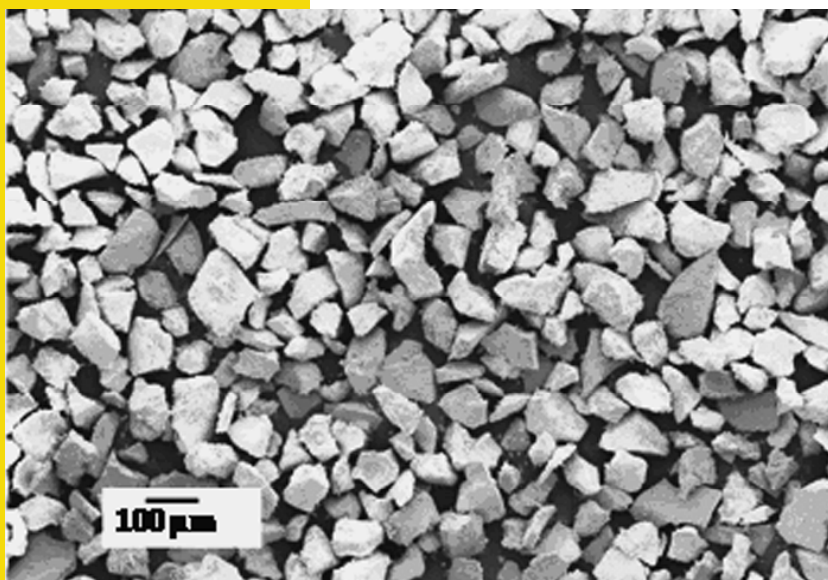
Plasma spray coatings for the Energy Sector

Plasma spray coatings that can find application in Solid Oxide Fuel Cells (SOFCs) and high temperature solar selective coatings have been developed. SOFCs are highly efficient energy conversion devices that convert fuels like hydrogen and hydrocarbons electrochemically to electricity with negligible emissions of pollutants and are emerging as an alternative to conventional power generation.

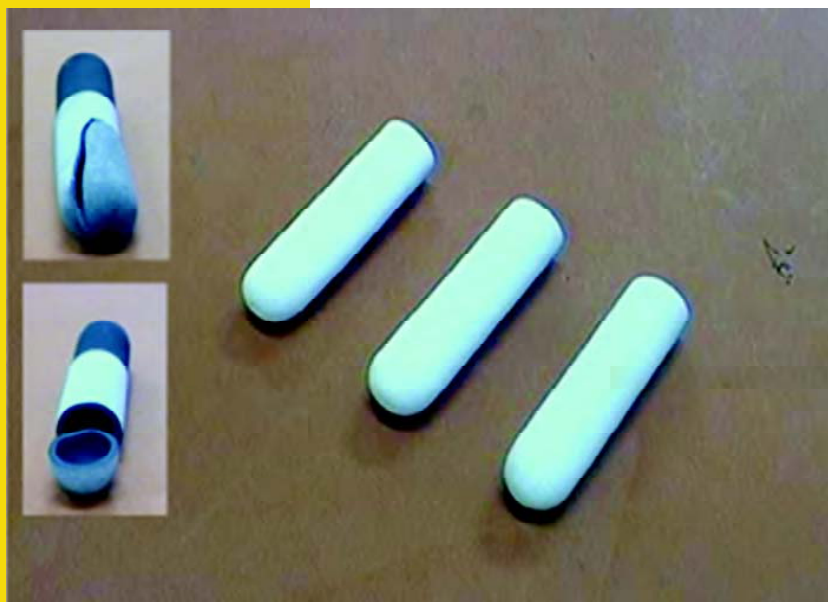
In recent years, with advances in the

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development of SOFCs, the biggest challenge facing the industrial application of SOFCs is the high manufacturing cost (~3000 Euro/kW). In this context, APS is a promising technique as it eliminates the multiple sintering cycles and also facilitates the use of robust, inexpensive metallic substrates as the mechanical support and electrical interconnects of the cells. The sintering-induced reaction/degradation can be eliminated in APS. However, the challenge is to fabricate electrolyte and interconnect layers with 0% open porosity and up to 40% open porosity for anode and cathodes.



SEM image of 8 mol% YSZ powders



Electrolyte coated ceramic tubes and inset shows the broken ceramic tubes during plasma spraying

Plasma sprayable 8 mol% Y_2O_3 stabilized zirconia (electrolyte for SOFC) powders were indigenously prepared by a chemical co-precipitation route without the agglomeration step, with ~75% yield at half the cost of commercial powder. By adjusting the processing parameters, the precursors and precipitating agents, various sizes of YSZ powders were prepared. A patent has been filed in India and USA (IN 59/NF/2008 and US2010/0048379) for this process.

A distinctive feature of the process is the microwave drying step that facilitated the cutback in the processing time by 10 hours. Plasma sprayable anode material (NiO-YSZ) and interconnect material (doped $LaCrO_3$) were also prepared by chemical co-precipitation method (Fig. 1). Solution combustion method, a process most widely used for the preparation of nanosize particles was suitably modified to prepare micron size, plasma sprayable NiO-YSZ, yttria stabilized zirconia (YSZ) and gadolinia doped ceria (GDC) powders. These powders are being used as anode and electrolytes respectively in SOFC and are plasma sprayed. Plasma sprayable SOFC powders have also been prepared from nanosize powders by spray drying process.

APS is a very promising technique for the fabrication of tubular and metal supported SOFC. A major problem of breaking of porous ceramic tubes (strontium doped lanthanum manganite) was faced during plasma spraying. Only one patent literature (USPTO 5436426) addresses this problem and it describes a complicated procedure for cooling the tubes during spraying.

We have used a simple approach of gradual heating of the substrate by plasma along with the use of a suitable mandrel material and heat absorbing cushioning material before plasma spraying the powders. The problem of breaking of tubular ceramic substrates during plasma spraying was overcome and an Indian patent (0001NF2009/IN) has been filed for the same.

The plasma sprayed 8 mol% YSZ coatings after sintering showed gas tightness (gas leak rate $\sim 1 \times 10^{-6}$ mbar.l.s $^{-1}$ cm 2) and a conductivity value of ~ 0.94 Sm $^{-1}$ at 1073 K,

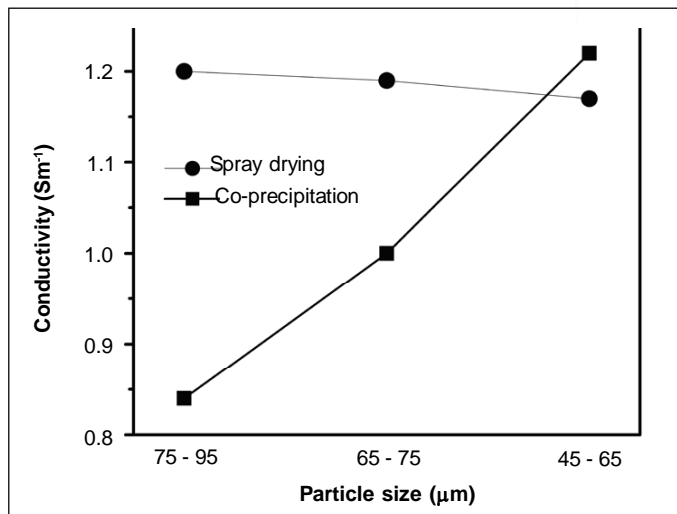
which is half of the value obtained for bulk sample ($\sim 1.7 \text{ Sm}^{-1}$). Plasma sprayable 10 mol% scandia stabilized zirconia, $\text{ZrO}_2:\text{Sc}_2\text{O}_3$ (ScSZ) coating has been proposed to be used as solid electrolyte for intermediate temperature SOFCs due to its higher electrical conductivity.

ScSZ layer was fabricated by APS using powders prepared by a chemical route without the agglomeration steps. The overall conductivity measured at 773 K for plasma sprayed ScSZ free form was $\sim 7.19 \times 10^{-4} \text{ S/cm}$ which is higher than the reported values at the same temperature for the plasma sprayed ScSZ coating ($\sim 1 \times 10^{-4} \text{ S/cm}$). Our study on the effect of feedstock on the microstructural and electrical characteristics of YSZ electrolyte coating revealed that the coatings fabricated from the smaller sized particles prepared from precipitation method possess necessary microstructural features and electrical characteristics akin to that of spray dried powders.

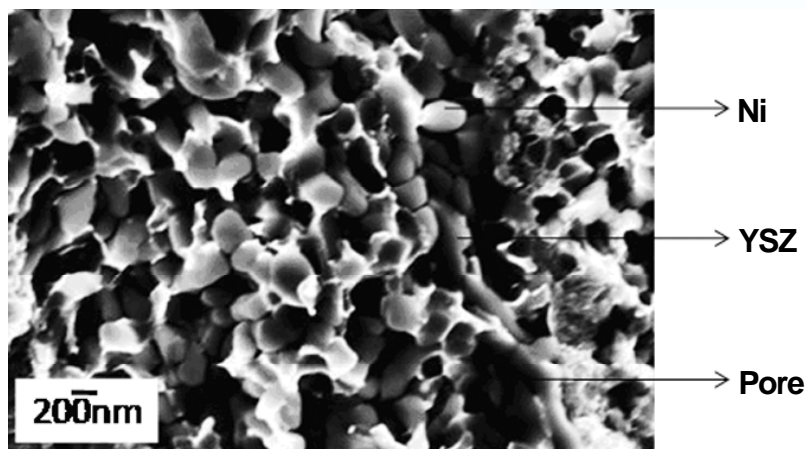
APS is a preferred technique for anode layer fabrication as one can get the desired porous anode coating directly by adjusting the plasma spray parameters without the need for any further sintering step with large number of triple phase boundaries that can enhance the performance of SOFC. Dense interconnect coating of calcia doped LaCrO_3 was also developed by APS.

Plasma spray process is a cost-effective and highly promising technique for the integrated fabrication of medium temperature SOFC units. Currently, we are developing such coatings under the 12th FYP CSIR

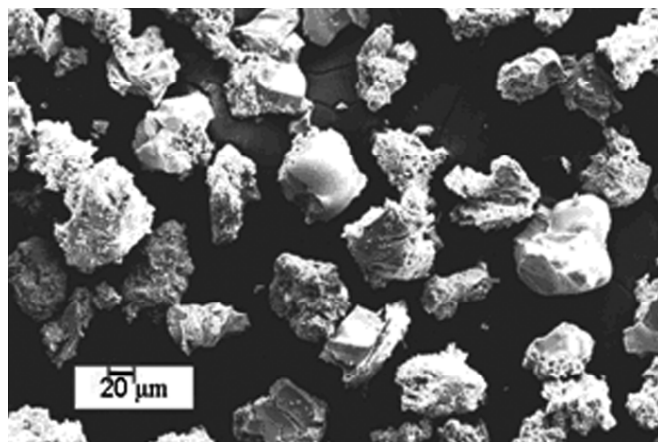
network project *Advanced ceramic materials and components for energy and structural applications* (CERMESA).



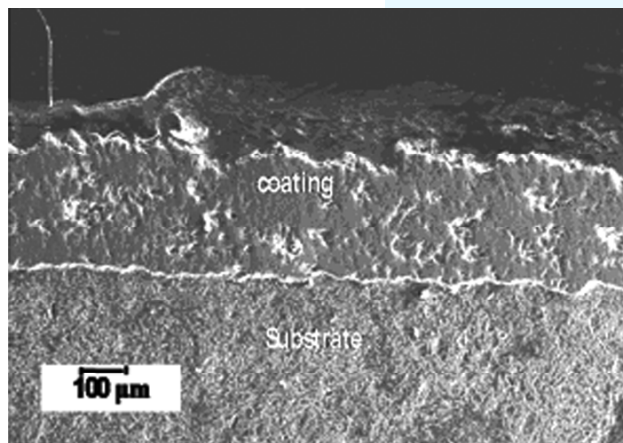
Variation in the conductivity of the coatings fabricated using co-precipitated and spray dried powders



Fine microstructure of Ni/YSZ (after reduction)



FESEM images showing the morphology ScSZ powder



Cross-sectional FESEM image of ScSZ plasma sprayed coating showing good adhesion with the substrate

Currently, all the thermal spray industries in the country are dependent on imported YSZ powders for TBC applications. The in-house developed plasma sprayed YSZ coatings have almost matched the properties of the commercial YSZ coating. Efforts are being focused towards scaling up and transferring the technology of powder preparation to industry.

For concentrated solar power applications, such as solar tower and parabolic dish concentrators, about 20% of incident solar energy is lost at the absorber/receiver due to reflectance (>5%) and emission by thermal radiation (>15%). To improve the efficiency of absorber/receiver, a temperature resistant and chemically stable *spectrally selective coating* with high *solar absorptivity* and low *thermal emissivity* is applied on the receiver surface. Spectrally selective black coating suitable for such application was generated by plasma spraying using solution precursor as the feed stock on stainless steel substrates. The developed coatings showed high temperature stability (600°C/100 hour) and the best coating exhibited solar absorptivity of 0.911 and thermal emissivity of 0.22.

The advantages of such coatings are: no need for drying or curing of coatings, less number of steps, inherent high temperature stability of the coating, environment friendly and it is easy to restore the worn out coating. However, some of the challenges to be overcome for the commercialization of this coating include thickness control and warpage of the substrates during plasma spraying.

Plasma spray coatings for Aerospace Sector

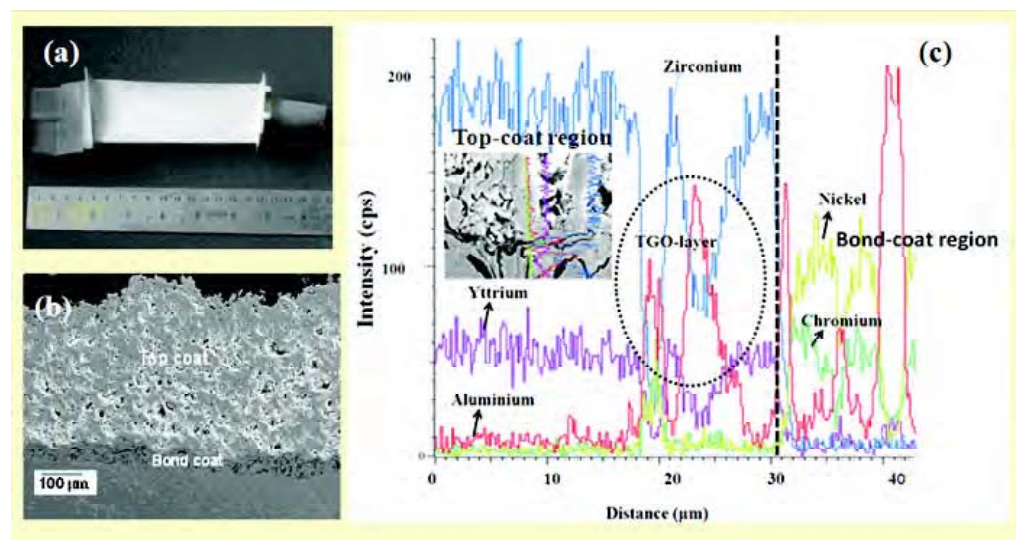
Gas-turbine engines are used mainly in aerospace to propel aircrafts. Their efficiency

and core power are directly related to the gas temperature entering the turbine section. Ceramic thermal barrier coatings (TBCs) have been used for decades to extend the life of combustors and gas turbine stationary and rotating components and are usually deposited by plasma spray technique. Plasma sprayed yttria stabilized zirconia (8 wt% YSZ) is a common TBC system that is widely used in the aerospace and automotive industries.

The properties of ceramic layers obtained from plasma spraying method depend strongly on the properties of the powders used. The coating fabricated with co-precipitation powder exhibited thermal conductivity (0.75 W/mK) close to that of commercial coating (0.69 W/mK). Also, the coatings exhibited similar oxidation resistance without any spallations and the thermally grown oxide thickness was less than 10 mm after 1000 thermal cycles of 15 min heating at 1100°C.

Currently, all the thermal spray industries in the country are dependent on imported YSZ powders for TBC applications. The in-house developed plasma sprayed YSZ coatings have almost matched the properties of the commercial YSZ coating. Efforts are being focused towards scaling up and transferring the technology of powder preparation to industry.

With the need to increase the temperature of the turbine engines, the continued use of



Plasma sprayed 8wt% YSZ coating on a gas turbine blade from (a) in-house synthesized powder; (b) cross-sectional FESEM image of the TBC and (c) EDX Line scan spectra of the TBC after 1000 thermal cycles at 1100°C showing <10mm thick thermally grown oxide (TGO) layer

YSZ has become problematic. $\text{La}_2\text{Zr}_2\text{O}_7$ is the most widely studied alternative TBC material as it has lower thermal conductivity than YSZ. Plasma sprayable $\text{La}_2\text{Zr}_2\text{O}_7$ powders were prepared by a simple and single step solution combustion method and the obtained coating exhibited a thermal conductivity of $1.08 \text{ W m}^{-1}\text{K}^{-1}$ at 900°C .

World-wide research efforts are being focused on the development of new coatings for TBCs with reduced thermal conductivity and higher thermal expansion coefficient compared to the state-of-the-art YSZ topcoat material. To obtain TBCs with such synergistic properties, the concept of bilayered coatings appears to be promising and currently work is on to develop such coatings.

Plasma spray coatings for Engineering Sector

Wear and corrosion are the major degradation modes that limit the service life of engineering components. To protect engineering components from wear, heat or corrosion, thermal spray and especially plasma spraying appears to be an efficient and a potential alternative to traditional coating manufacturing techniques (such as hard chrome electroplating) for the production of wear-resistant coatings.

Amongst plasma-sprayed ceramic and cermet coatings, alumina (Al_2O_3) is the most widely established coating for many applications in textile, electronic, aerospace, and aircraft industries because of their dielectric and wear resistant properties. Thermally-sprayed Al_2O_3 is widely employed to protect components against sliding, abrasive and erosive wear in a number of applications like rolls, pump bodies and plungers, industrial machinery parts.

Usually α -form of alumina is used for plasma spraying. During plasma spraying, alumina transforms from its α -form to γ -form. High amounts of γ -alumina in the plasma sprayed coating will result in poor wear resistance. We have reported the preparation of plasma sprayable γ - Al_2O_3 powder without the use of any conventional agglomeration step like spray drying and the

coatings generated using γ -alumina powder possessed mainly α -form and exhibited a synergistic combination of wear and corrosion resistance along with good spallation resistance even at 1100°C .

On the other hand, coatings prepared with spray dried alumina under similar plasma spray conditions showed very poor spallation resistance. This was attributed to the poor melting of spray dried alumina powders. Improved wear resistance was observed with carbon nanotubes reinforced alumina coatings. Plasma sprayable titania, mullite and alumina-titania powders have been prepared and the evaluation of their wear and corrosion resistant properties are in progress.

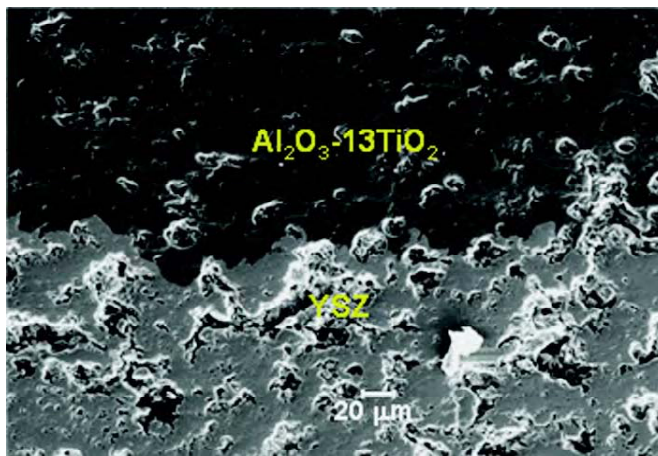
Plasma spray coatings for Biomedical Sector

Titanium and its alloys are being extensively used for orthopedic implants. Biomedical Ti alloys are prone to undergo degradation due to the combined effect of wear and corrosion. To overcome these problems, surface modification techniques are being used. Thick plasma-sprayed hydroxy apatite coatings are now being routinely applied to the shafts of hip endoprosthetic devices and to dental root implants. Implants made of Al_2O_3 , zirconia (YSZ) and coatings of titania (TiO_2) are known to be biocompatible.

For the first time, we reported bilayered plasma spray coating containing nanostructured yttria stabilized YSZ and alumina-titania (AT) layers on biomedical Ti-13Nb-13Zr alloy. The bilayer coating possessed a substantially higher microhardness ($1096 \pm 10 \text{ HV}$) which is ~ 1.3 times that of AT ($820 \pm 22 \text{ HV}$) and ~ 1.8 times that of YSZ ($617 \pm 25 \text{ HV}$) coatings. The bilayer coating showed lower porosity compared to AT and YSZ coatings. The corrosion studies in simulated body fluid conditions showed lowest i_{corr} $0.025 \mu\text{Acm}^{-2}$ for the bilayer coatings when compared to that of the AT ($1.2 \mu\text{Acm}^{-2}$), YSZ ($4.3 \mu\text{Acm}^{-2}$) coatings and substrate ($4.49 \mu\text{Acm}^{-2}$). Thus plasma sprayed YSZ/AT seems to be a more promising coating for improving the corrosion resistance of



Wear and corrosion are the major degradation modes that limit the service life of engineering components. To protect engineering components from wear, heat or corrosion, thermal spray and especially plasma spraying appears to be an efficient and a potential alternative to traditional coating manufacturing techniques (such as hard chrome electroplating) for the production of wear-resistant coatings.



FESEM image of plasma sprayed bilayer coating

biomedical Ti-13Nb-13Zr alloy rather than the monolayer coatings of YSZ and AT.

Currently, under the 12th FYP CSIR network project on bioceramics, research activities are focused towards the development of coatings using a combination of solution precursor plasma spray and atmospheric plasma spraying with the aim of obtaining synergistic mechanical and bio-compatibility properties along with higher corrosion and wear resistant properties for the coatings on biomedical Ti alloys.

Dr. Aruna Reddy and collaborators at CSIR-NAL

Technology Transfer

CSIR-CGCRI Glass Lining Technology goes into Production



A view of the inaugural function. Dr. Someshwar Datta and Mr. K. Dasgupta are seen seated third and fourth from left

CSIR-Central Glass and Ceramics Research Institute (CGCRI), Kolkata developed a novel composition for glass-lining coating material and a process of its application on metallic substrates. On 29 June 2012, an agreement for licensing of its know-how was signed by CSIR-CGCRI with Standard Glass Lined Equipments Pvt. Ltd., Hyderabad. A year later, the industrial manufacturing unit has started production.

Glass-lining is a corrosion resistant coating used in chemical or food processing reactors or equipments to enhance product

quality and service life of the reactors by prevention of chemical corrosion. A special type of impervious glassy coating was developed for application on metallic reactors or equipment by conventional vitreous enameling technique.

Following the agreement, the company initially assimilated the technology in a small scale and established its credibility by supplying vessels/reactors. Standard Glass Lined Equipments Pvt. Ltd. earned an order worth `70 lakhs and subsequently established within a short period of time, a full scale industrial manufacturing unit to manufacturing up to 30,000 litres capacity of glass lined vessel/reactors.

The unit was inaugurated by Mr. Kamal Dasgupta, Acting Director, CSIR-CGCRI on 29 May 2013. The Chief Guest on this occasion was Dr. Someswar Datta, the inventor of this technology. The entire unit started production with immediate effect.

In a press meet during the inaugural function, Dr. Datta explained the importance and novelty of the glass-lining technology. He also joined Mr. Dasgupta in briefing the assembled journalists about CSIR-CGCRI's research activities. Prominent national dailies



from Hyderabad covered the programme.

Section of the production line in the glass lining manufacturing unit of Standard Glass Lined Equipments Pvt. Ltd., Hyderabad based on CSIR-CGCRI technology



Meetings

CSIR-CLRI Releases Colours for Spring Summer 2015 Season

Prof. Dr. A.B. Mandal, Director, CSIR-Central Leather Research Institute (CLRI), Chennai released the first copy of Colours for the Spring Summer 2015 season to Mr Yavar Dhala M., Convenor, Finished Leather Panel, Council for Leather Exports (CLE) on 7 June 2013 at Hotel Taj Coromandel, Chennai. The event demonstrated yet another unique initiative from CSIR-CLRI in their endeavour of advance preparedness for the Indian Leather Sector.

At the Leather Panel Meeting, Shri Md Sadiq of the Shoe Design and Development Centre, CSIR-CLRI spoke on *India's involvement and participation at the MODEUROP Congress and the Leather Incubator Project*. Mr Sadiq mentioned that many discerning tanneries and product manufacturers have been requesting for the MODEUROP Colour card for the Autumn Winter 14/15 season beginning end-April 2013/early May 2013 itself, indicating an advancement in the seasonal requirements of the discerning buyers from India. He detailed the various events that unfolded during the MODEUROP Meeting including Pre-selection, Review of the season past, Colour Voting, Networking, Colour Trend and Texture presentation for MODEUROP Autumn Winter 14/15 season, etc.

In the concluding part of the presentation, Mr. Sadiq added that in the long run a Leather Incubator was the need of the hour to sustain such activities. He acknowledged Mr. N. Shafeeq Ahmed, Vice Chairman, CLE and Chairman, IFLMEA,



Prof. Dr. A.B. Mandal, Director, CSIR-CLRI releasing the first copy of the COLOURS for the Spring Summer 2015 season with Mr. Yavar Dhala M., Convenor, Finished Leather Panel, CLE

whose brainchild it has been for a while now. The mandate of the Leather Incubator is to nurture a culture of developing new leathers based on seasonal demands, so that the designs and concepts metamorphose into newer and niftier products or services capable of being marketed and sold. The outcome is creation of a new class of world-class leathers.

The Leather Incubator will use the experience in Leather Design and Trends from Italian Leather Designers and International Chemical Companies and with counterparts from India with expertise in the field. The Leather Incubator will look forward to work with Textile Associations in bringing International Fashions faster to



its members, and will also take membership to International Fashion Organizations.

The Leather Incubator is expected to serve the members of the Indian Leather Industry through:

- User Requirements Engineering
- Contextual Inquiry and User Research
- User Interface
- Interaction Design
- Surface Design and Texture Visualization
- User Interface Design Inspection
- Design Process Audits
- Design Training
- Design Capability Building and Institutionalization
- User Experience Design Consulting



View of the debate on formulating, implementing and achieving significant growth and enhancement of global market share in the finished leather sector

Mr. Sadiq informed the august gathering that the concept of Leather Incubator had been earlier discussed at a design debate organised jointly by the Council for Leather Exports and the Indian Shoe Federation and has been incorporated as a proposal in the White Paper on *Design Needs of the Indian Leather Sector* that the Council had presented to the Government of India. Thanking CLE for the opportunity given to CSIR-CLRI to make this presentation and the audience for their kind attention, he invited the Members of the Finished Leather Panel of CLE to support the endeavour.

MoUs

CSIR-CRRI signs MoU with Bombay Textile Research Association



Signing of MoU between CSIR-CRRI and BTRA

CSIR- Central Road Research Institute (CRRI), New Delhi, signed an MoU with the Bombay Textile Research Association

(BTRA) in Mumbai on 22 May 2013. The broad objectives of the MoU are:

- To establish close linkage and functional coordination between CSIR-CRRI and BTRA
- To work collectively for the sector in geosynthetics, particularly geotextiles, for road and transportation sector
- Mutual sharing of resources to accelerate the use of geotextiles in road construction and maintenance including usage of library at both ends
- Submission of joint proposals to MORTH/NRRDA on comprehensive evaluation of geotextiles

CSIR-NML Brass Melting Furnace Technology brings hope to Moradabad Artisans



Prof. Samir Kumar Brahmachari, Shri Gaurav Ohri, Dr. K.L. Sahoo and Dr. Sam Pitroda at the event during the signing of the agreement

The brassware industrial cluster of Moradabad, U.P. has always been in the news for the wrong reasons – adding to the pollution level and global warming due to the use of traditional inefficient furnaces — rather than being a vibrant hub for manufacturing and exporting of brassware artifacts.

CSIR-National Metallurgical Laboratory (NML), Jamshedpur, in association with the National Innovation Council, has now taken up the challenge to upgrade the traditional technology through implementation of appropriate innovations for these brassware clusters. A CSIR-NML team comprising Dr. K.L. Sahoo, Shri K.K. Paul, Dr. D. Mandal and Dr. P. Poddar has already developed an energy-efficient coke-based brass melting furnace. The furnace has a capacity of 3-10 kilogrammes per batch for casting of artifacts, and is cost effective, fuel efficient and eco-friendly.

An agreement was signed on 25 June 2013 between CSIR-NML and the Moradabad Industrial Development Co. Pvt. Ltd. (MIDCO), Moradabad in presence of Dr. Sam Pitroda, Adviser to the Prime Minister on Public Information Infrastructure and Innovation and Chairman, National

Innovation Council and Prof. Samir Kumar Brahmachari, DG-CSIR and Secretary, Dept. of Scientific and Industrial Research, Govt. of India at Yojana Bhavan, New Delhi. Shri Gaurav Ohri, Director, Moradabad Industrial Development Co. Pvt. Ltd. and Dr. K.L. Sahoo, Principal Scientist, CSIR-NML signed the agreement. CSIR-NML transferred the technology to M/s MIDCO.

The existing furnaces in Moradabad are not fuel efficient. They are also opened at the top, resulting in direct exposure of workers to toxic flue gas along with heavy suspended particulate matter and also adds to atmospheric pollution. With the development of the CSIR-NML technology, these shortcomings will be minimized. Further, the newly designed furnace reduces coke consumption by 20-40%, melting time by 20%, and also reduces suspended particulate matter emission to the atmosphere.

This societal intervention by CSIR-NML has benefited 3.5 lakh brass artisans of Moradabad. Technology development and its transfer has been done free of charge. CSIR-NML is also looking forward to implementation of the technology in other brassware clusters in India.

Training Programmes

Faculty Training and Motivation Programme Conducted at CSIR-NIO

CSIR-National Institute of Oceanography (NIO), Goa organized a four-day *Faculty Training and Motivation Programme* for high school teachers from Goa during 25-28 June 2013. The programme was funded by the CSIR-Human Resource Department Group (HRDG), New Delhi.

The programme was aimed at re-energizing teachers, exposing them to different fields of oceanography, hands-on research and imparting them with confidence, enthusiasm and also knowledge about the world of oceans. The participants were encouraged to learn the content and process of scientific inquiry by engaging in research and group discussions and communicating their findings to others. The lectures were well chosen to address a central theme on Ocean Science, consisting of topics like global change — science and effects, a journey to the icy continent, new trends in marine biotechnology, etc. The training provided an opportunity to the teachers to interact with some of the eminent workers from the scientific community.

The programme included demonstration of specialized equipments such as Atomic Absorption Spectrometer, laboratory visits to aquaculture labs housing sea horse and ornamental fishes, and marine archeology museum with artifacts from ancient maritime equipments. Group discussions on environmental issues were also initiated. Researchers working in independent laboratories provided pro bono mentoring in diverse fields of oceanography.

CSIR-NIO's outreach programme is conducted every year and has successfully trained 153 teachers from various schools across Goa since its inception in winter 2004. This year the programme was attended by fifteen science teachers from different schools of Goa.

Dr. S.W.A. Naqvi, Director, CSIR-NIO congratulated the participants and awarded certificates during the concluding session. Smt Maria Brenda L. Mascarenhas Pereira, Senior Scientist, HRDG, CSIR-NIO, and the Coordinator of the programme proposed the Vote of Thanks.



Participants of the Faculty Training and Motivation programme with Dr. S.W.A. Naqvi, Director, CSIR-NIO

CSIR-CIMAP Imparts Training to Women on *Agarbatti* making



Training on making of *agarbattis* from the powder of floral bioresource was organised on 29 June at the Women Entrepreneurial Training Facility (WETF) of CSIR-Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow. The venue of the training was Chandrika Devi Temple, near village Kathwara, BKT, Lucknow.

The women were taught the complete knowhow for making raw *agarbattis*, followed by perfuming and packaging. They were also given important tips in marketing.

The programme conducted by Dr. R.P. Bansal and Dr. A.K. Singh was attended by about 25 participants from different villages of Lucknow and Kanpur. These included a group of four women participants sponsored by a IIT-Kanpur based NGO Svagatagami.

CSIR-CIMAP's project is empowering the women and enabling them to earn additional income while at the same time protecting the environment by using offered or discarded floral bioresource.



Women being taught *agarbatti* making technique

National Technology Day Celebrations

CSIR-Central Building Research Institute

CSIR-Central Building Research Institute, (CBRI), Roorkee celebrated the National Technology Day on 10 May 2013. Prof. S.P. Gupta, Deputy Director, IIT-Roorkee graced the occasion as Chief Guest and delivered a special lecture. He highlighted various scientific achievements and motivated the S&T staff for taking interest in understanding the principles and practical applications of science. The Chief Guest further stressed that science should be explored for the benefit of mankind so as to improve health, income and living standard of the common masses.

Earlier, Prof. S.K. Bhattacharyya, Director, CSIR-CBRI, in his Presidential

Address, remarked that May 11 is annually observed as the National Technology Day all over India to commemorate technological breakthroughs like mastering of nuclear weapons technology through a series of controlled tests at Pokharan, test firing of the indigenously developed Trishul missile and test flight of the indigenous aircraft *Hansa-3*. These achievements of Indian technology got a further boost with the test firing of the indigenously developed Trishul, Agni and Prithvi missile. The day is therefore used to inspire young minds to achieve high goals and excel at innovations. He also highlighted R&D achievements of CSIR.

The celebrations were also marked by the transfer of a technology on Fire Extinguishments to M/s Aska Equipments Ltd., New Delhi. Shri Rajeev Ragav, Chief Marketing Officer, delivered a technical presentation.

On the occasion, Dr. Suvir Singh, Senior

Principal Scientist, also gave a technical presentation on Cable Penetration Seal System (Cable Fire Stop), for which he received the Diamond Jubilee Technology Award. Dr. R.S. Chmote, Chief Scientist, gave a live demonstration on Fire Extinguishment Techniques.



Technology transfer to
M/s Aska Equipments Ltd.,
New Delhi



Live demonstration of
Fire Extinguishment Techniques

CSIR-Central Scientific Instruments Organization

The National Technology Day was celebrated at CSIR-Central Scientific Instruments Organization (CSIO) on 13 May 2013 by holding an open day from 9.00 am to 1.00 pm. All the laboratories of CSIR-CSIO were kept open for the general public. About 500 visitors, including students

from various schools, engineering colleges, universities and general public from Punjab, Haryana Himachal Pradesh and Chandigarh went around the laboratories of the organization. They directly interacted with the scientists and were given exposure to the technologies developed at CSIR-CSIO.



A view of the National Technology Day
function at CSIR-CSIO

During a function to celebrate the National Technology Day, Dr. Girish Sahni, Director, CSIR-CSIO highlighted the significance of Technology Day and narrated the contributions of CSIR-CSIO in different areas such as medical, social and defence sectors. He called upon the staff of CSIR-CSIO to make concerted efforts in R&D in areas directly related to the masses and leading to improvement of quality of life. He said that the challenge before CSIR-CSIO is to convert scientific research into patents and products useful to the society. Dr. Sahni also stressed on the importance of partnership and collaboration.



Later in the afternoon, Chief Guest Dr. Manjit Singh, Director, Terminal Ballistics Research Laboratory, Chandigarh delivered the Technology Day Lecture on *Photonics and Detonators*. He enlightened the audience about Nano Energetics as an emerging research area, and dwelled on the importance of involving young researchers in the new projects.

Dr. Singh applauded the contributions of CSIR-CSIO in the area of Defence, Agrionics, Nano Science and Photonics. He said that there is an opportunity of collaboration with CSIR-CSIO in the area of fast optical instruments, pyrometers to

measure transient explosion effects, temperature, photonics to measure detonics, blast measurement systems, laser-based projectile measurement systems and laser initiation of explosives.

Earlier a quiz contest was also conducted by Dr. Navneet Singh Aulakh in which questions related to science and technology and about National Technology Day and CSIO/CSIR were asked. The enthusiasm of the participants was remarkable.

The programme concluded with the Vote of Thanks by Dr. C. Ghanshyam, Chief Scientist, CSIR-CSIO.

Honours and Awards

CSIR-IICT Scientist conferred N-BIOS Prize-2012

Dr. S. Venkata Mohan, Senior Scientist, Bioengineering and Environmental Centre (BEEC), CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad has been conferred with the prestigious National Bioscience Award for the year 2012 by the Department of Biotechnology (DBT), Government of India. The award has been conferred for his outstanding research contributions in developing new technologies for the production of clean biofuels from waste.

The National Bioscience Award for Career Development or N-BIOS Prize is a coveted honour conferred by the Government of India upon select young Indian bioscientists of less than 45 years of age. The award is given annually for unique contributions made towards the development of state-of-the-art technology in basic and applied areas of biological sciences through demonstrated activity in the form of publications in reputed journals or patents. The award is considered equivalent to the Shanti Swarup Bhatnagar Prize given by the CSIR.

Dr. Venkata Mohan is doing extensive research on generation of biohydrogen, bioelectricity and bioplastics from wastewater. For the past fifteen years, he is involved in

developing sustainable wastewater treatment plants by integrating bioenergy generation. Renewable energy generation from waste will reduce fossil fuel usage which is a major contribution to greenhouse pollution.

Dr. Venkata Mohan is one of the leading scientists in the world in the area of bioenergy from waste and has published about 180 research papers and has six patents. His publications are widely cited all over the world with more than 3700 citations.

Dr. Venkata Mohan is a recipient of prestigious awards such as ProSPER.NET-Scopus Young Researcher Award in Sustainable Development-2010 in Energy Category by the United Nations University, M/c Elsevier and International Bureau of the BMBF (Fist Indian recipient of the award), NASI-Scopus Young Scientist Award in Earth, Oceanographic & Environmental Sciences-2010 by The National Academy of Sciences and M/s Elsevier and Alexander von Humboldt Fellowship, Germany. He is also a Visiting Professor at Kyoto University, Japan.



CSIR-CDRI Scientists Awarded INSA Medal for Young Scientists-2013

For the year 2013 two scientists from CSIR-Central Drug Research Institute (CDRI), Lucknow Dr. Arun Kumar Trivedi and Dr. Susanta Kar have received the INSA Medal for Young Scientists.



Dr. Arun Kumar Trivedi received the INSA Medal for Young Scientists for his work on identification of novel E3 ligases in leukemia using proteomic approaches and elucidating their mechanism in pathogenesis. Presently, he is a Scientist in the Drug Target Discovery and Development Division, CSIR-CDRI.

Dr. Arun Kumar Trivedi obtained his M.Sc. from the Banaras Hindu University, Varanasi and Ph.D. from LMU Munich, Germany. He did his post-doctoral work at the State Centre for Cell and Gene Therapy, Martin Luther University, Halle, Germany. His area of research specialization is molecular biology of Acute Myeloid Leukemia and role of C/EBPalpha in cancer. His current area of research interest includes: (a) Understanding protein degradation pathways: role of important E3 ubiquitin ligases in degradation of crucial transcription factors and signaling proteins, and (b) Identification of interacting proteins of C/EBPalpha and their role in myeloid differentiation and leukemogenesis: a mass spectrometry based proteomics approach.



Dr. Susanta Kar received the INSA Medal for Young Scientists for his studies on the mechanism of activation and deactivation of macrophages during visceral leishmaniasis. He is a Scientist in the Parasitology Division, CSIR-CDRI.

Dr. Susanta Kar obtained his M.Sc. from Calcutta University, Kolkata and Ph.D. from the CSIR-Indian Institute of Chemical Biology, Kolkata. Subsequently, he worked as post-doctoral Research fellow at the CSIR-IICB, and then Quick Hire Scientist at CSIR-CDRI.

His current area of research interest includes: (a) Understanding the mode of action of promising anti-leishmanial agents and characterising new pathways and their components to better understand the molecular and cellular mechanisms of the infection process in leishmaniasis, and (b) Deciphering the basic mechanism of macrophage-Leishmania interaction with special emphasis on identification of negative regulatory proteins by which Leishmania turns off the various signaling cascades in phagocytic cells.

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