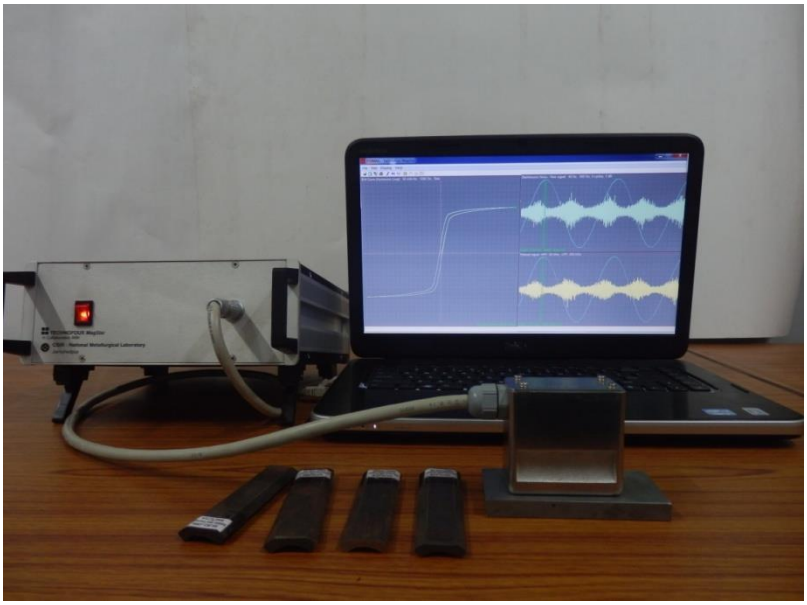
TECH PROFILE: MagStar

1.	Title of Product/Process/Design/ Equipment	**MagStar:** A Portable Magnetic Hysteresis and Barkhausen Emissions based Electromagnetic Device for damage assessment of Steel Structure/Component nondestructively
2.	Summary	The developed electromagnetic device works by exciting the sensor by an alternating current source. The sensor is to be placed on test body to get signal corresponding to the characteristics of the test objects. The output signals from the sensor are the measure of the magnetization, coercivity and magnetic noise (Barkhausen emissions) which change with microstructure and stress state of the materials.
3.	IPR status	Patented
4.	Application/Uses and Target Industry Sector	Evaluation of microstructural changes / generation of ferromagnetic phases during heat-treatment/ ageing and its correlation with mechanical properties. It can be used for residual stress analysis. Application in automotive & Aviation sectors.
5.	Salient Technical Features	(a) Magnetic Hysteresis Loop (MHL) measurement : Frequency Range: 20mHz to 200mHz, Excitation: 0-1500 Oe, Wave Shape : Sinusoidal / Triangular, (b) Magnetic Barkhausen Emission (MBE) measurement: Frequency Range : 10Hz to 200 Hz, Excitation: Up to 1500 Oe, No. of Cycles : 3 to 10, Gain : 0 - 20 dB (in steps of 1 dB), Filter setting 10KHz to 300KHz. Power Requirement : 230V, 50Hz, 200VA, Weight :3.25Kg, Control, Display and Analysis : External laptop /notebook/ PC
6.	Level/Scale of Development	TRL-8
7.	State of commercialisation	Licensed for manufacturing to M/s Technofour, Pune, on non-exclusive basis. Four units sold to NTPC (NETRA), BARC, JSW (R&D) and IIT (BHU) & Royalty received by CSIR-NML.
8.	Major Raw Materials to be Utilized	Electronic components, Soft magnetic core materials.
9.	Major Plant Equipment and Machinery Required	Sensing probe, power source, amplifier, data acquisition & analysis system.

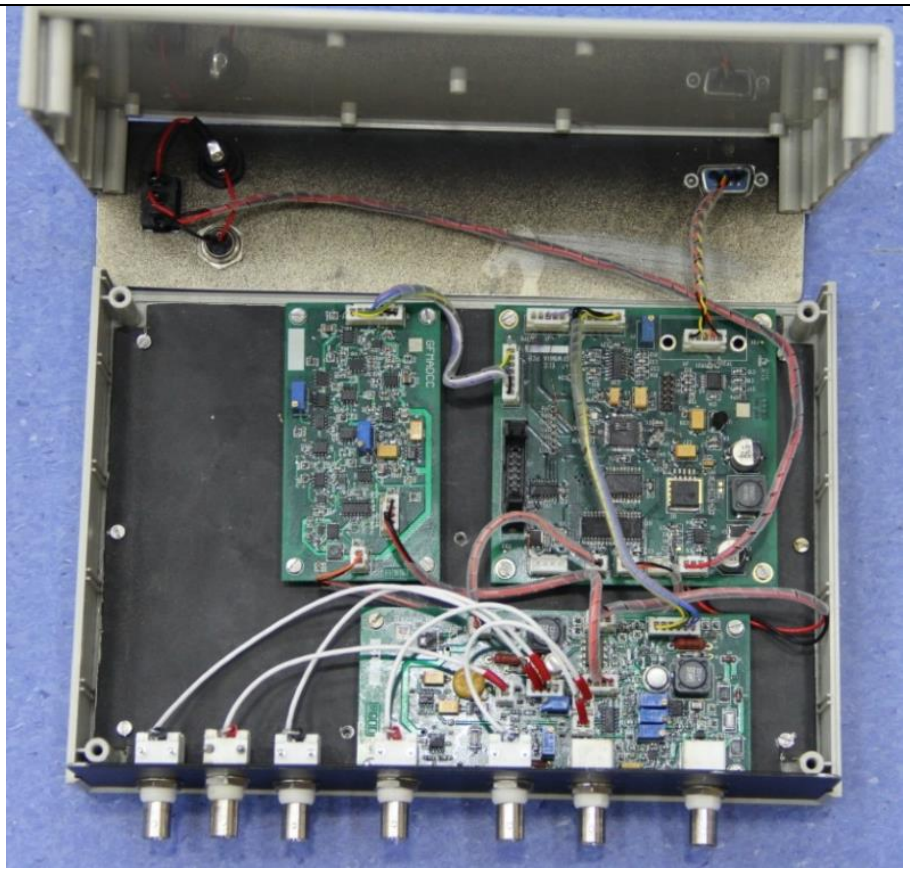
Latest Photographs of the Product/Technology



TECH PROFILE: UFG

1	Title of Product/Process/ Design/Equipment	**Ultrasonic Flow Gauge (UFG):** A device for fluid flow rate measurement through a narrow tube.
2	Summary	Flow rate of fluids through a narrow tube for example propellant gauging of spacecraft can be estimated using the device. This can also be used as a gas and liquid flowmeter. Light weight, low power consumption, analog as well as digital output ports, test points in the circuits, capable of measuring flow rate from 0.1 LPM to 6 LPM are the major salient features of this device.
3	IPR status	Yet to be patented. Technology transferred to M/S Electronic & Engineering Co Ltd , Mumbai
4	Application/Uses and Target Industry Sector	Onboard Fluid estimation of spacecraft, aero-engine, gas flow rate measurement
5	Salient Technical Features	Features of the present system are as follows: • Measurement Accuracy <0.1% FSO • Flow rate range Up to 100 cc/s • Mass ≤ 500g • Operating Temperature range -40 to +200^{o}C • Delay time resolution between upstream and downstream velocity ~ 0.2 ns • Analog outputs: 02 • Ports for measuring downstream transit time (t_d), Upstream transit time (t_u) and difference in transit times (dT) • Digital Display for displaying dT • Saving option for 100 data
6	Level/Scale of Development	TRL-7
7	State of commercialisation	Licensed for manufacturing to M/s Electronic & Engineering Co Ltd, Mumbai on non-exclusive basis. One unit delivered to LPSC, ISRO. Order received for 4 more units
8	Major Raw Materials to be Utilized	Electronic components,
9	Major Plant Equipment and Machinery Required	Sensing probe, power source, amplifier, data acquisition & analysis system.

Latest Photographs of the Product/Technology



TECH PROFILE: Sodium Metal

1	Title of Product/Process/Design	**Indigenous design of closed cell and development of technology for industrial production of Sodium metal first time in India.**
2	Brief Description	Sodium metal has extensive applications in chemical and metallurgical industries especially in drugs, pharmaceutical, petroleum, plastic and atomic sectors and the total demand in India is met by import only. The CSIR-NML has designed, commissioned and produced sodium metal successfully in closed sodium cell at 500A capacity at NML, Jamshedpur. Based on the success, the 2000A sodium cell was scaled up and commissioned at HWP, Baroda. The pilot scale sodium cell was further scaled up to 3000A capacity and operated successfully at M/s SRHHL, Kurnool, AP. Based on the pilot scale expertise, the industrialization of sodium cell (48000A capacity) is under progress at M/s SRHHL, Kurnool.
3	Application/Uses	Drugs & pharmaceuticals, petroleum, atomic sector (coolant in FBR)
4	Scale of Development	**TRL- 9** (industrialization) is under progress.
5	Salient Technical Features	The sodium metal is produced by molten salt electrolysis of sodium chloride. The sodium cell is designed indigenously and an attempt is under way by CSIR-NML to produce sodium metal at industrial scale at 2 tonne per day first time in India using commercial sodium chloride.
6	Industrial Partner	M/s Sree Rayalseema Hi-Strength Hypo, Ltd. (SRHHL), Kurnool, AP
7	Major Raw Materials Utilized	Commercial sodium chloride, barium chloride, calcium chloride, etc. Sodium chloride is the main raw material of the process.
8	Major Plant Equipment	AC and DC power source, raw material handling equipment, electrolyser, chlorine gas treatment equipment, melting furnace, etc

500A sodium cell at NML

2000A sodium cell at HWP, Baroda

3000A sodium cell at M/s SRHHL

Produced sodium metal

TECH PROFILE: Gadolinium

1	Title of Product/Process/Design	**Development of indigenous technology for production of rare earth metal (Gadolinium)**
2	Brief Description	Gadolinium **(Gd)** metal, costly metal, belongs to rare earth metal (REM) family. Gadolinium metal is used as a shielding and liner material in nuclear reactors, medicinal and magnetic applications. The total demand of the metal is met by imports only. CSIR-NML has developed an indigenous technology first time in India for production of gadolinium metal by fused salt electrolysis of gadolinium chloride. At NML the experimental parameters were optimized and scale-up of 100A cells were designed and operated successfully. About 500 g of gadolinium metal (99.7% purity) was supplied to IGCAR, Kalpakkam for their captive use. The experiences enable CSIR-NML to produce gadolinium metal indigenously to meet the future demand of gadolinium metal in India.
3	Application/Uses	Medicinal, magnetic, electronics, atomic sector
4	Scale of Development	TRL- 7
5	Salient Technical Features	The gadolinium metal is produced by molten salt electrolysis of gadolinium chloride. The closed electrolytic cell is designed indigenously by CSIR-NML which can produce 200 g of gadolinium metal per day.
6	Industrial Partner	IGCAR, Kalpakkam (sponsor)
7	Major Raw Materials	Commercial gadolinium chloride, potassium chloride, lithium chloride, etc.
8	Major Plant Equipment	AC and DC power source, closed electrolyser, chlorine gas treatment equipment, melting furnace, etc

Electrolyser

As-produced Gd Metal

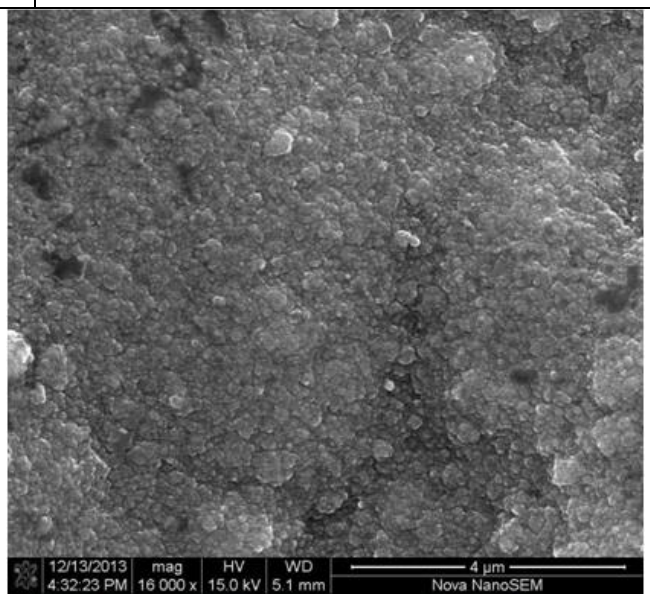
Gd metal powder

ARC melted Gd Metal

TECH PROFILE : Cd Replacement Coating- Al Electroplating using Ionic Liquid

1.	Title of Product/Process/ Design/ Equipment	**Electrodeposited Al from ionic liquid for Cd replacement coating**
2.	Summary	Al coatings were electrodeposited on high strength steel from ionic liquid-$AlCl_3$ bath using various current pulses and evaluated for Cd replacement coating. The deposition current in bipolar mode produces compact and pore/defect free coating.
3.	IPR Status	In the process of patent filling by the Sponsor
4.	Application/Uses and Target Industry Sector	Cathodic protection of steel as Cd replacement coatings. Target industries are aviation and automotive sector.
5.	Salient Technical Features	The coating provides cathodic protection to steel in water and salt water, red rust resistance for ≥ 1000 and 500 hours in salt spray chamber, humidity resistance for more than 500 hours. The coating resists hydrogen embrittlement.
6.	Level/Scale of Development	TRL-3
7.	State of Commercialization	Lab scale
8.	Major Raw Materials Utilized	Ionic liquid and anhydrous $AlCl_3$
9.	Major Plant, Equipment and Machinery Required	Bipolar current source.

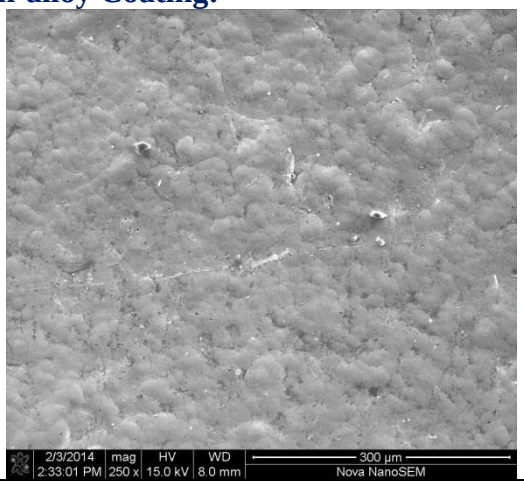
Photograph and SEM image of Electrochemically Deposited Al coating using ionic liquid



TECH PROFILE : Compositionally Modulated Multilayered Alloy (CMMA) Coatings For Cd Replacement

1.	Title of Product/Process/ Design/ Equipment	**Electrodeposited CMMA Zn-Alloy Coatings for Cd Replacement**
2.	Summary	Zinc Based Compositionally Modulated Multilayered Alloy (CMMA) coatings were electrodeposited on high strength steel aqueous bath using bi-polar pulsed DC power. The deposition process was optimized and the developed coatings exhibited similar behaviour as that of electroplated Cd.
3.	IPR Status	The IPR is with the Sponsor
4.	Application/Uses and Target Industry Sector	Cathodic protection to high strength steel that are prone to hydrogen embrittlement so as to replace toxic Cd platings. Target industries are aviation and automotive sector.
5.	Salient Technical Features	The coating provides cathodic protection to steel both in normal water and saline water. Have high red rust resistance for ≥ 1000h in salt spray chamber, humidity resistance for more than 500h. The coating resists hydrogen embrittlement and ideal for Cd replacement.
6.	Level/Scale of Development	TRL-3
7.	State of Commercialization	Lab scale
8.	Major Raw Materials Utilized	Commercial Chemicals
9.	Major Plant, Equipment and Machinery Required	Bipolar current source.

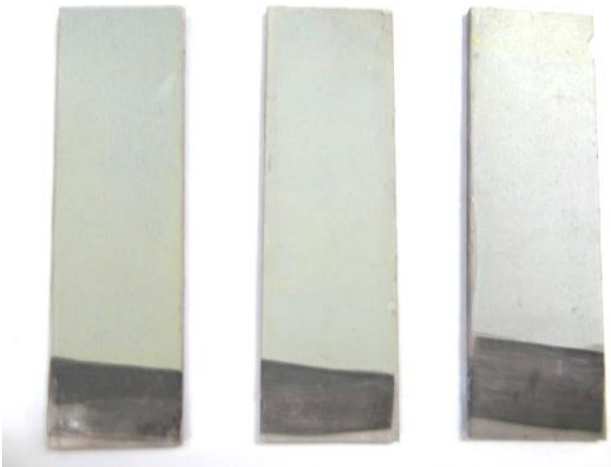
SEM image of CMMA Zn-alloy Coating:



TECH PROFILE : Cadmium Replacement Coatings: Al-alloy coatings by PVD techniques

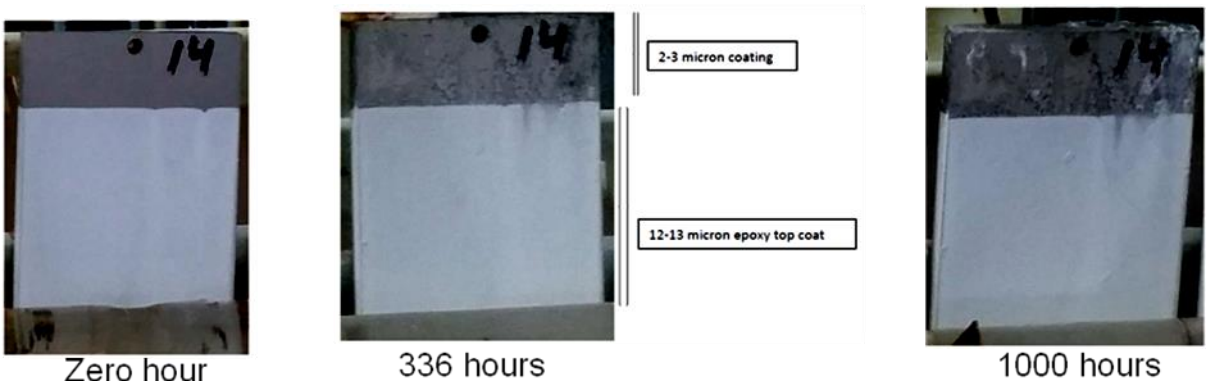
1.	Title of Product/Process/ Design/ Equipment	**Aluminium Alloy Coatings by Sputtering process for Cd Replacement**
2.	Summary	Pure Aluinium coatings do not provide cathodic protection to steel in normal water. Therefore, Al alloy coatings are sputter deposited on high strength steel using RF magnetron sputtering process. The deposition process was optimized and the developed coatings exhibited similar behaviour as that of electroplated Cd.
3.	IPR Status	The IPR is with the Sponsor
4.	Application/Uses and Target Industry Sector	Cathodic protection in normal and saline water to high strength steel that are prone to hydrogen embrittlement so as to replace toxic Cd plating. Target industries are aviation sector.
5.	Salient Technical Features	The coating provides cathodic protection to steel both in normal and saline water. Red rust resistance for ≥ 1000h in salt spray, Humidity resistance > 500h. The coating reveal excellent resistance for hydrogen embrittlement and ideal for Cd replacement
6.	Level/Scale of Development	TRL-3
7.	State of Commercialization	Lab scale
8.	Major Raw Materials Utilized	Al-alloys
9.	Major Plant, Equipment and Machinery Required	RF/DC Magnetron Sputtering System

Photographs of Sputtering System and Al Coatings:



TECH PROFILE: HEXA Cr Free Coating for Al Alloys

1	Title of Technology (Product/ Process/Design/Equipment)	**Cr(VI) free coating for corrosion protection of aluminium alloys (AA 2024)**
2	Summary	Toxic Cr (VI) conversion coatings are used on all Aluminium alloys especially in aerospace industry to improve corrosion resistance and paint adhesion. CSIR-NML has developed a Cr(VI) free polymeric coating using polymeric corrosion inhibitors. Conversion coating on Aluminium alloy AA2024 was done successfully using the polymer. The coating provided corrosion resistance and paint adhesion similar to Cr(VI).
2	IPR Status	Know how developed- IPR will be with the Sponsor
3	Application/Uses and Target Industry Sector	Replacement of toxic Cr(VI) conversion coating for corrosion protection of AA 2024 alloys. Target industry: Aerospace
4	Salient Technical Features	1. Chrome free polymeric coating for AA2024 alloy 2. Fast and low temperature curable (less than 30 min, less than 80^0 C) 3. Meet the requirements in MIL-DTL-81706 (336 hours of salt spray test and cross hatch adhesion test)
5	Level/ Scale of Development	TRL – 3
7	Status of Commercialization	Yet to be commercialized
8	Major Raw Materials to be Utilized	Commercially available chemicals
9	Major Plant Equipment and Machinery Required	Dipping tanks with heating facility, spray gun
10	Photographs (please provide high quality photographs of proof of concept & validation)	Please see below



Salt spray results for AA 2024 panels