



**BMS**  
Estd: 1946

**College of Engineering**  
Autonomous College under VTU  
Approved by AICTE | Accredited by NBA

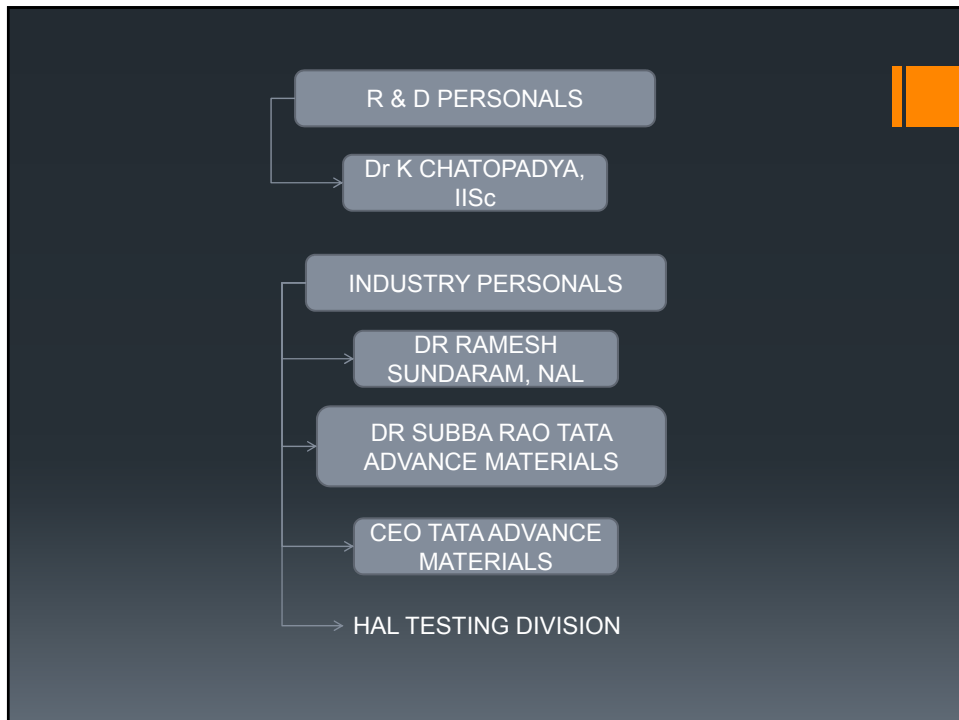
## Centre of Excellence in “Advanced Materials Research”

No. AC / TEQIP-II / CoE / 13 / 864 Dtd 12 July 2013

## Advisor and Principal Investigators

Advisor: Dr. P. Martin Jebaraj, Director R&D

1	<b>Dr.M.Ramachandra</b> Professor, Mech Engg Dept	<b>Coordinator and Principal Investigator</b>
2	<b>Dr.S.Srinivas</b> Associate Professor, Mech Engg Dept	<b>Principal Investigator</b>
3	<b>Dr.Murugendrappa</b> Associate Professor, Physics Dept	<b>Principal Investigator</b>
4	<b>Dr.Chandasree Das</b> Asst Professor, E& E Engg Dept	<b>Principal Investigator</b>



## The Objectives of COE

- To develop core competences in Synthesis, Characterisation and Processing of
  - ✓ Nanocomposites (Polymer and metal matrix)
  - ✓ Memory Materials
  - ✓ Sensor Materials
- Processing of Composites – Abrasive Water Jet Cutting
- To develop a community of resourceful individuals in advanced materials.

## The Objectives of COE

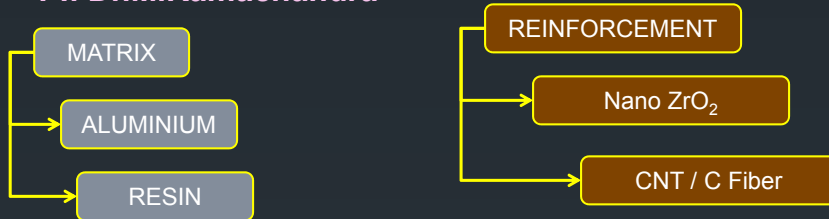
- To be a source of information about materials, processes and technologies.
- To provide high quality education programs in Post graduation and PhD in advanced materials science and technology.
- To conduct seminars, conferences and other educational activities related to advanced materials as well as applications.
- To promote faculty collaborations across institutes, industries.

## Deliverables of COE:

- **Nanocomposite (Metal and Polymer based) and its post processing (Unconventional Machining)**
- **Material for Phase Change Memory (PMC) applications.**
- **Conducting polymers and Ceramics as sensors - Humidity & Gas sensors.**
- **Establishment of state of the art Advanced materials research lab at BMSCE**
- **Starting of a New PG program in Manufacturing science and engineering at BMSCE**

## Metal Matrix Nanocomposite and Polymer Composites

PI: Dr.M.Ramachandra



- Synthesis
  - Squeeze casting and
  - Powder Metallurgy processes / Resin-RTM & AutoClave
- Characterisation
- The developed material will be tried for its possible automotive applications.

## Metal Matrix Nanocomposite and Polymer Composites-Applications

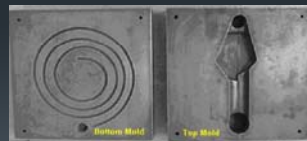
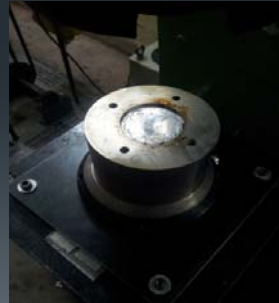
PI: Dr.M.Ramachandra

- Metal Matrix Nano Composites
  - In automotive engineering the application is in the engine area
    - piston rod, piston and piston pin;
    - Cylinder head
    - cylinder blocks.
  - Another possible application of Metal Matrix Nanocomposite is bearings where wear resistance is an important property of the material used.

### Polymer composites:

- Impact resistance material which finds its application in Car and Truck Bodies.
- special coatings for composite materials used in air craft for withstanding high temperature especially in LCA wing portion that carries Air to Air missiles
- To develop Carbon nanotube reinforced polymer composite which finds its application in windmill blades.

# Nanocomposite synthesis and Characterisation



# Publications

International Journal of Composite Materials 2014, 4(1): 21-29  
DOI: 10.5923/j.comaterials.20140401.04

## Effect of Hot Rolling on Al-4.5%Cu Alloy Reinforced Fly Ash Metal Matrix Composite

G. N. Lokesh<sup>1\*</sup>, M. Ramachandra<sup>2</sup>, K. V. Mahendra<sup>3</sup>

MultiCraft

International Journal of Engineering, Science and Technology  
Vol. 5, No. 4, 2013, pp. 71-79

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### Characterization of Al-Cu alloy reinforced fly ash metal matrix composites by squeeze casting method

G. N. Lokesh<sup>1\*</sup>, M. Ramachandra<sup>2</sup>, K. V. Mahendra<sup>3</sup>, T. Sreenith<sup>1</sup>

# Publications

International Journal of Engineering Inventions  
e-ISSN: 2278-7461, p-ISSN: 2319-6491  
Volume 3, Issue 4 (November 2013) PP: 01-08

## Effect of Squeeze pressure on the hardness and wear resistance of Aluminium flyash composite manufactured by stir-squeeze casting

K.N.P. Prasad<sup>1</sup>, M. Ramachandra<sup>2</sup>

<sup>1</sup> Associate Professor Dept of Industrial Engineering & Management BMSCE Bangalore  
<sup>2</sup> Professor Dept of Mechanical Engineering BMSCE Bangalore

International Journal of Modern Engineering Research (IJMER)  
www.ijmer.com Vol. 3, Issue. 5, Sep - Oct. 2013 pp-2501-2509 ISSN: 2249-6645

## Evaluation Of Factors Affecting Sliding Wear Behaviour Of Al-Flyash Metal Matrix Composites By Using Design Of Experiments

K.N.P. Prasad<sup>1</sup>, M. Ramachandra<sup>2</sup>

<sup>1</sup> Associate Professor, Dept of Industrial Engineering & Management, BMSCE, Bangalore, India  
<sup>2</sup> Professor, Dept of Mechanical Engineering, BMSCE, Bangalore, India

## ABRASIVE WATERJET CUTTING OF METAL MATRIX COMPOSITES

PI:Dr.S.Srinivas

- Machining of PMCs, MMC's and Metal Matrix Nano composites is difficult with conventional cutting tools and because of this it is finding limited applications.
- Hence unconventional machining techniques can be tried and process capability studies can be made.
- This helps the industries to adopt PMCs, MMC's and Metal Matrix Nano composites as an alternative to conventional alloys.
- **INTERACTIONS**
- Prof Chattopadhyay, IISc and
- Prof Satish Kailash, IISc

## ABRASIVE WATERJET CUTTING OF METAL MATRIX COMPOSITES

PI:Dr.S.Srinivas



Model 1515



Cutting head tilting = 0-60°

X-Axis Travel	1575 mm
Y-Axis Travel	1575 mm
X-Axis Table Size	2337 mm

30 hp Pump with Max Pressure of 50,000 psi (350 MPa)

## ABRASIVE WATERJET CUTTING OF METAL MATRIX COMPOSITES

PI:Dr.S.Srinivas

### Deliverables

- This setup can become one of the facilities in Manufacturing Laboratory in M.Tech program (Manufacturing science and Engg)
- Several UG and PG level in-house projects
- Various MOU's with industrial organizations in the similar fields can be made
- Consultation Work can be takenup

## ABRASIVE WATERJET CUTTING OF METAL MATRIX COMPOSITES

PI:Dr.S.Srinivas

### Action Plan

Sl.No.	Activity Block	Scheduled Plan for 2014		
1.	Procurement of Materials and Equipment	July		
2.	Installation and trial runs		Sept	
3.	Preliminary and detailed experiments , analysis and documentation			Dec
4.	Modeling and verification of model	2015		



## ABRASIVE WATERJET CUTTING OF METAL MATRIX COMPOSITES

PI:Dr.S.Srinivas

### Present Status

Procurement of Abrasive water jet cutting  
M/C

National Competitive Bidding

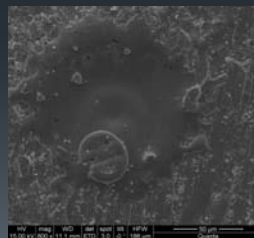
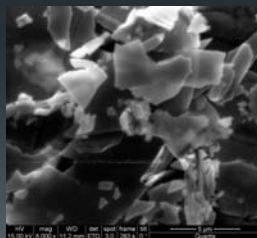
- Bidding
- Opening of Bids
- Technical Evaluation of Bids
- Purchase order to be released

Design of die for castings completed

## Synthesis and Characterization of Phase Change Memory materials (Application- Computer RAM)

PI: Dr. Chandasree Das

- Morphological Characterization of Phase Change Memory materials using X-Ray Diffractometer (XRD) and Scanning Electron Microscopy(SEM).
- Study the mechanism of switching phenomenon in phase change memory materials.



## Synthesis and Characterization of Phase Change Memory (PCM) materials

PI: Dr. Chandasree Das

- Future Plans
  - Optical Characterization
  - Device Fabrication
  - Product development
- Equipment under procurement
  - Dual Sputtering Coating Unit
  - Two target holders
  - Substrate heater with controller
  - Substrate rotation controller

## Synthesis and Characterization of Phase Change Memory (PCM) materials

PI: Dr. Chandasree Das

### Interaction & Collaboration

- Indian Institute of Science, Bangalore
- IIT, Indore
- Manipal University, Manipal

### Publications

1. Chandasree Das, G. Mohan Rao and S. Asokan, 'Electrical Switching Behavior of Amorphous  $Ge_{15}Te_{85-x}Si_x$  Thin Films Having Phase Change Memory Applications', **Materials Research Bulletin**, 49 (2014) 388.
2. G. Sreevidya Varma, Chandasree Das and S. Asokan, 'Evidence of an intermediate phase in a quaternary Ag bearing telluride glass system using alternating DSC', **Solid State Communications**, 177 (2014) 108.
3. R.T. Ananth Kumar, Chandasree Das, S. Asokan, C. Sanjeeviraja and D. Pathinettam Padiyan, 'Optical, photo-acoustic and electrical switching studies of amorphous  $GeS_2$  thin films', **Applied Physics A: Material Science & Processing**, (available online).
4. Chandasree Das "Electrical Switching Studies on  $Ge_{15}Te_{75}In_{10}$  Amorphous Thin film" in International Conference on Thin Films & Applications, held at SASTRA University, Thanjavur, from September 10<sup>th</sup> – 13<sup>th</sup> 2013.

## Synthesis and Characterization of Conducting Polymers for Sensors Applications

PI: Dr. Murugendrappa M.V

In this study, **polypyrrole** is used as a conducting polymer,

- Zinc Tungstate  $ZnWO_4$ ,
- Strontium Arsenate  $Sr_3(AsO_4)_2$
- Sodium meta vanadate  $NaVO_3$

ceramics are used to make composites with polypyrrole to tailor various electric and sensor properties of polypyrrole.

## Synthesis and Characterization of Conducting Polymers for Sensors Applications

PI: Dr. Murugendrappa M.V

- **Synthesis**
  - Chemical method
- **Characterization**
  - SEM, XRD, IR, TGA.
- **Electrical Properties**
  - AC/DC conductivity
  - Dielectric
- **Sensor Properties**
  - Gas (LPG) & Humidity

## Synthesis and Characterization of Conducting Polymers for Sensors Applications-Present Status

- Synthesis of the conducting polymer composites has been completed.
- Characterization of the synthesized composites by employing XRD, FTIR and SEM is also completed.
- AC conductivity study of the composites is in progress.

### Paper published

- **Title:** “Dielectric spectroscopy of conducting polymer and ferroelectric composites”
- **Journal:** **International Journal of Science Research**  
Volume 01, Issue 04, 2013, pp 250 – 254.

## Planned Facilities at COE

Sl No	Description of Works/Goods	Estimated Cost (Rs)
1	Scanning Electron Microscope (SEM)	100,00,000
2	X-Ray Diffraction analyzer (XRD)	70,00,000
3	Abrasive Water Jet machine (AWJ)	90,00,000
4	FTIR Spectroscopy equipment	11,00,000
5	UV/VIS Spectro-Photometer	6,00,000
6	Impedance Analyzer With Solid sample holder	12,00,000
7	Dual Sputtering Unit	16,00,000
8	Conductivity setup	8,00,000

## **R&D Collaboration: NAL, HAL, TATA Advanced Materials**



- Research in futuristic polymer composites for impact resistance material which finds its application in Car and Truck Bodies.
- Research in special coatings for composite materials used in air craft for withstanding high temperature especially in LCA wing portion that carries Air to Air missiles.

## **R&D Collaboration: Magod Laser Machining Pvt Ltd**



R&D collaboration with **Magod Laser Machining Pvt Ltd** Bangalore for applicable research and product development. The collaboration activity will be for research in machining of advanced materials using water jet and Laser beam methods.


## **R&D Collaboration: CMTI, Bangalore**



R&D collaboration with **CMTI, Bangalore** for applicable research and product development. The R&D collaboration activity is in the field of


- Laser beam dressing of CBN wheels
- Cryogenic machining of Aerospace materials
- Additive manufacturing of composites
- Coating of tools by CVD

## **R&D Collaboration: NOPO Nano-Technologies, Bangalore**




- R&D collaboration with **NOPO Nano Technologies India Pvt. Ltd** for applicable research and product development. The collaboration activity will be for development of Nobel Prize winning material Carbon called graphene for applications in civilian and military areas.

## R&D Collaboration: Sical Abrasives, Bangalore



- R&D collaboration with **Sical Abrasives**, Shimoga for applicable research and product development.

## Collaboration with institutions abroad



- The BMSCE is one of the stake holder members of India Platform that facilitates the collaborative research between the European universities and Technical Institutions in Karnataka.
- As part of the MOU, the representatives from European Universities visited Bangalore in April 2013. In continuation of this, Dr.G.N.Sekhar, Vice Principal & TEQIP Coordinator-I & Dr.M.Ramachandra, Coordinator-CoE have visited the universities at Groningen, Ghent, Antwerp and Averio to explore the possibilities for mutual collaborations in the thematic areas of CoE during October 1-12, 2013 and established contacts for collaboration.

## COMPONENT 3 & 4

Component 3: Collaborating with industry for applicable research and Product development

NAL+ TATA ADVANCED Materials +CMTI in Resin Transfer Moulding (RTM) and twin roll (TR) Process development

Out Lay 1<sup>st</sup> Year 0.25  
2<sup>nd</sup> Year 0.15  
3<sup>rd</sup> Year 0.1

Component 4: National / International collaboration for R & D activities with academic and R & D organizations

Centre for Soft Matter Research (CSMR) + India Platform the European Union Universities + Martin Luther University Halle

Out Lay 1<sup>st</sup> Year 0.25  
2<sup>nd</sup> Year 0.15  
3<sup>rd</sup> Year 0.1

## Review Meeting

Prof Kamanio Chattopadyaya

- As per the directions of the State Project Co-ordinator, SPFU, Karnataka, a review meeting of the activities of COE in advance materials research was held on 6.2.2014 under the chairmanship of Prof Kamanio Chattopadyaya, IISc.




## Meeting with Prof. Satish Kailash of IISc,

- The proposed research on Abrasive Waterjet Cutting of Metal Matrix Composites (MMC) including development of models was appreciated and accepted by Prof. Satish Kailash.
- He suggested to think of alternate methods for MMC production.
- He suggested to execute the research as per the proposal given and then to extend this study on new materials.
- He also assured to extend the facility available at IISc to measure the surface roughness.
- The same was briefed to Prof. Chattopadhyaya of IISc, Mentor, COE.

## New PG Program

- **Manufacturing Science and Engineering**

## International conference on Advanced materials and Manufacturing



- An international conference on Advanced materials and Manufacturing is being planned to be conducted during the month of February 2015.

*THANK YOU*