SUKSHMA

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President's Message

Dear Colleagues

As you may already know, the Institute of Smart Structures & Systems (ISSS) was registered as a Professional Society in 1998 by a group of colleagues, with the intention of nurturing evolving disciplines such as smart materials and structures, and micro devices and systems in India. These technologies have transformed many aspects of our own lives over the last two decades. It has pervaded into areas such as structural health monitoring, self-healing materials, and most importantly nano science and technologies.

The role played by ISSS has also evolved over the last two decades. During the first decade the society focused on conducting familiarization workshops, triennial international conferences, seminars, and even publishing a monograph. As we approached the second decade, ISSS started annual national conference, quarterly Newsletter, and later, a biannual Journal. We have also opened local chapters at multiple cities in the country.

As we get into the third decade of its existence, the Governing Council of ISSS envisage opening up new frontiers of engaging and enlarging its membership and reach. A new series of events such as Researchers' Forum (the first event being held in IISc on March 27-28, 2018) and 'Women in Technology' Forum (to be announced soon) are planned. LinkedIn and facebook pages have been opened. While these would supplement conventional modes of engaging with the membership such as the Newsletter we may need to transform our seminar series also into online platforms for wider dissemination among members in the nook and corner of our vast country.

While the Governing Council can plan and support some of these engagements, participation from a wider base of membership alone can bring success to these activities. I therefore would like to take this opportunity to call upon the members of the Society, especially youngsters, to come forward as volunteers and work towards the success of these endeavours. I also wish to thank all our senior colleagues for their wisdom and continued support in planning the future of this Society as it transcends adolescence and grows into a mature institution. Jai Hind.

K .J. Vinoy

To

Technical Talk @ Nitte Meenakshi Institute of Technology

Micromachined Accelerometer

Prof. G.K. Ananthasuresh, IISc. Bengaluru

Date: 29th Jan. 2018

Snapshots of ISSS event at NMIT

The Institute of Smart Structures and Systems (ISSS), began a series of technical talks across Bangalore for the year 2018 with a presentation of Prof. G.K. Ananthasuresh, Professor, Mechanical Engineering Dept. Indian Institute of Science, at Nitte Meenakshi Institute of Technology, Bengaluru, on 29th January 2018. The title of the talk was: Micromachined Accelerometer". The audience for the talk were students of 4th and 6th semester of various engineering branches along with faculty members. The event began by Prof. Veda S.N. giving a brief introduction to ISSS and its objectives giving emphasis on the education subcommittee. Prof. Veda also apprised the audience on the benefits of joining ISSS as student / annual / life members.

Prof. Ananthasuresh began his lecture by introducing the audience on the fundamental principle of operation of an accelerometer. Key details regarding the application and design issues of accelerometers were presented. The talk focussed on the design of a Displacement Amplification Compliant Mechanism (DaCM). Prof. Ananthasuresh also distributed a design worksheet to the audience and guided them to design many DaCMs during the course of his talk. He also encouraged the students to independently design DaCMs and send him the design. He offered to fabricate the best DaCM in his next fabrication run in March 2018, provuded the design is sent my mid February.

The talk was well attended and the audience was very enthusiastic about the topic and has shown a lot of interest. Post his talk, many students have approached Prof. Veda to join ISSS and to get guidance towards continuing work in this exciting technology domain.

Breath analyzers: Sensors for common man

Centre for Applied Research in Electronics (CARE) IIT Delhi
Dr. Saakshi Dhanekar

Breath analyzers are expected to be simple, efficient and reliable sensors which can be used by common man at home or offices. Today sensors have become part of our day-to-day life, may it be electronic equipment, gadgets, automobile or even as human experiences. Broadly classified into categories like electrical, mechanical, optical, electrochemical etc. depending on the sensing scheme being used. Typically, sensors comprise of a sensing material (the heart of the sensor), contacts (for taking electrical measurements) and an advanced stage of a sensor called as a transducer which would contain a signal processing circuit which makes the information usable.

In a country like India, Sensors can be put to good use in a variety of sectors. The rural sector is in need of simple, low cost and easy to use sensors for water quality monitoring, continuous blood pressure checking, analysis of sugar level in blood, prediction of cancer at an early stage, heart diseases etc. The urban sector has similar requirements for some subgroups (communities) but also has specific requirements such as air quality monitoring, unobtrusive personal health monitoring, toxic gas detection etc. Hence, breath analyzers will be useful for both the rural and urban sector.

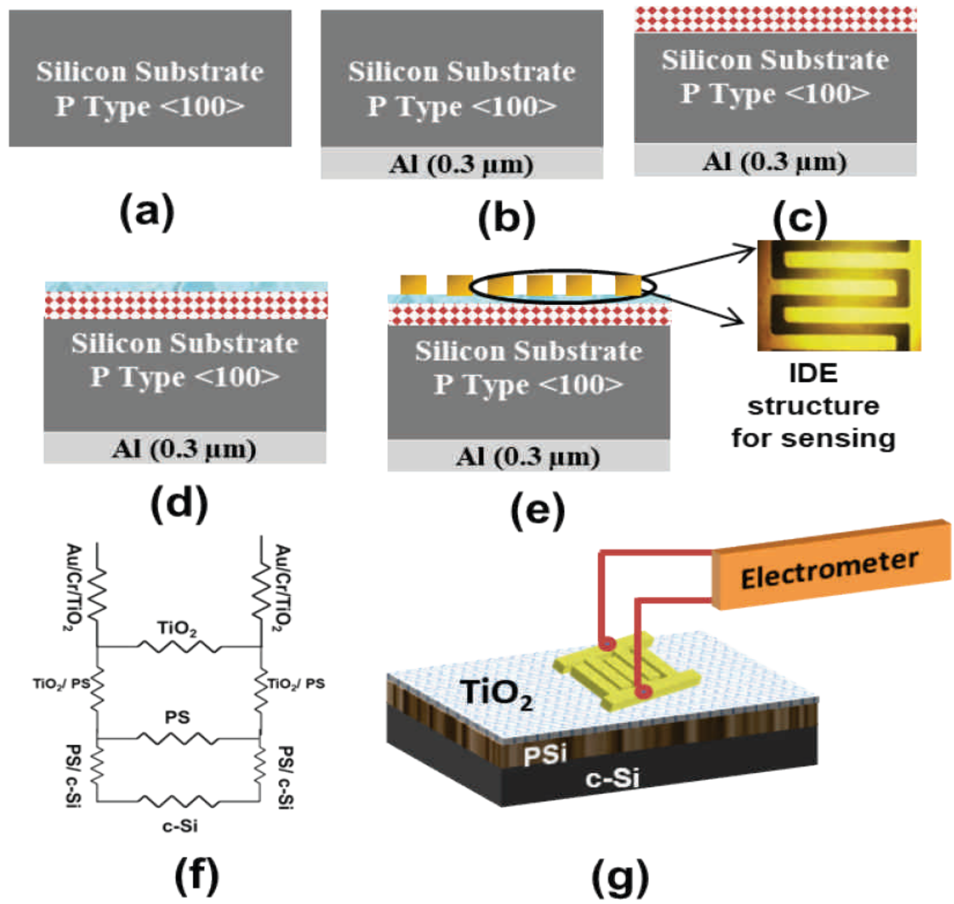

Fig. 1. (a) Wafer cleaning (b) Back side Al deposition for PS fabrication (c) PS fabrication (d) TiO_2 deposition on PS (e) Au/Cr for electrode fabrication (f) Electrical resistance equivalent model (g) 3D Schematic of TiO_2/PS sensor [1].

At IIT-D, our research revolves around a similar area where we try and develop scalable, cost effective and sensitive sensors for common citizens. These sensors are further packaged into a handheld device which can be used as breath analyzers. Our work mainly comprises of sensitive nano-materials, integration of these on the silicon chip, testing and validation of sensors in our labs, building of prototypes and thereby improving the user-electronic interface.

Some very interesting results have been achieved in the area of alcohol and acetone sensing through our work. Usual commercial sensors based on semiconductor oxide operate at higher temperatures (>250 °C). This limits their integration with current CMOS circuitry because of heat dissipation and high power consumption. Also, many wet processes are used for fabrication of sensors however, our technique is based on micro-fabrication standard processes and thus is scalable and reproducible. To bring down the operating temperature, we introduced a combination of metal oxide and nano-silicon (porous silicon) |(Fig. 1). The interface of the two materials, provide more movement of carriers at lower temperatures and thus, device operates at room temperature. Since, both materials are used in their nanostructure forms, the heterostructure also aids in improving the sensitivity.

Our sensors made with a combination of semiconductor oxide on porous silicon (PS) measures resistance and operate at room temperature. The materials which have been explored till now include titanium dioxide (TiO_2), molybdenum disulphide (MoS_2) and another form of molybdenum (Mo), all with a combination of nano-silicon. A detailed description of work done on TiO2 is presented here.

A thin layer of TiO_2 (using sputtering) on PS was deposited which made the sensor selective to ethanol among all volatile organic compounds (VOCs) tested [1]. The limit of detection of the sensor was around 5 ppm and was found to be extremely selective towards ethanol. FESEM image of TiO_2/PS (Fig. 2(a)) shows a porous morphology with very well connected pores formed into tracks of around 50 nm wide. The inset of Fig. 2(a) depicts the enlarged view of the underlying layer (PS) which has pores ranging in 4-6 nm in silicon. Fig. 2(b) displays cross-sectional view of the TiO_2/PS heterostructure with

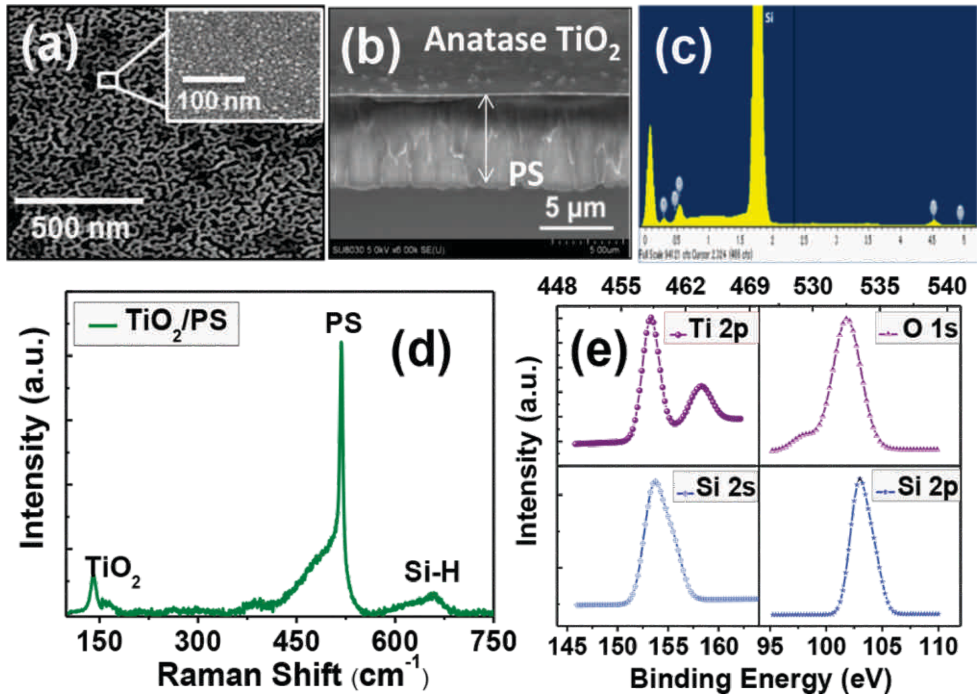

Fig. 2 TiO_2/PS sample (a) FE-SEM micrograph (b) cross-sectional FE-SEM image (c) EDS spectrum (d) Raman spectrum (e) X-ray photoelectron spectroscopy study of TiO_2/PS.

depth of PS pore ~ 5 μm. Energy dispersive x-ray spectroscopy (EDS) analysis confirmed that weight% of oxygen is greater than Ti and is in coherence with the structure prepared (Fig. 2(c)). Raman studies shown in Fig. 2(d) display Raman- active lattice vibrations confirming the presence of anatase phase . The peaks at 512 cm^{-1} with an asymmetry towards lower frequencies relate to nanocrystalline silicon. A small peak at 635 cm^{-1} originates from Si-H bond vibration . Fig. 2(e) depicts the XPS data which shows intense titanium peaks at 464 eV and 458 eV assigned to $Ti2p_{3/2}$ and $Ti2p_{1/2}$ respectively and to Ti^{4+} oxidation state [4,5]. One $O1_s$ peak at 532 eV was observed which arises due to oxygen species. Since substrate was PS, two intense peaks at 103.6 eV and 153.75 eV attributed to Si-2p and Si-2s (Si^{4+} oxidation state) respectively [6].

Sensing tests were performed in presence of various organic vapors like ethanol, IPA, acetone, xylene and benzene in 70%-90% humid environment. The sensor response was measured as a change in resistance of the device upon exposure to different analytes. It can be formulated as in (1),

where R_a and R_0 are the resistance change in presence and absence of analyte respectively.

The analyte concentration in ppm was controlled by maintaining their respective vapor pressures . The TiO_2/PS sensor was tested at different temperatures and different concentrations of ethanol. This demonstrated that maximum response was attained at around 100 °C (Fig. 3(a)). All the

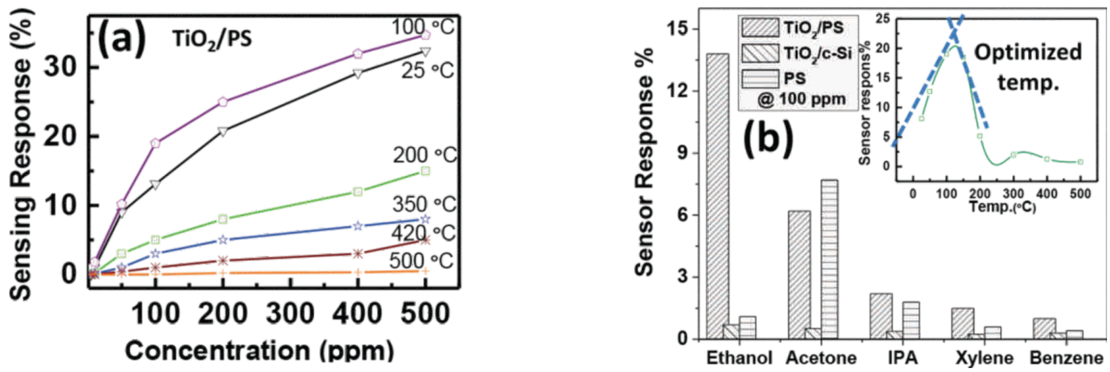

Fig. 3. Sensor response: (a) at various concentrations of ethanol and different temperatures, (b) given by all sensors for different analytes (inset shows optimized temperature range).

sensors including TiO_2/PS and its single layer counterparts were exposed to different analytes and it was found out that maximum response was for ethanol by TiO_2/PS with its response being 14 % at 100 ppm concentration (Fig. 3(b)). PS alone showed higher affinity to acetone in comparison to other VOCs tested. The inset depicts the working temperature of TiO_2/PS sensor at fixed concentration of ethanol of 100 ppm. Various studies were done with repeatable cycles and for six months to check the stability of sensor upon exposure of ethanol (Fig. 4(a)). The response was found to be repeatable and stable in nature.

In order to verify the process scalability, twenty devices fabricated from the same wafer were tested for different concentration of ethanol vapours (Fig. 4(b)). The results of devices (D1-D20) show almost similar sensor response with exposure to different concentration of ethanol vapours demonstrating process scalability. A prototype breath analyzer comprising of packaged sensor, microcontroller, display, ADCs, switches, current source, battery etc., in a form of optical image is presented in Fig. 4(c). A current source is used for providing an input to the resistive sensor. The output voltage is amplified and provided to ADC (analog-to-digital converter). The output of this is fed to the microcontroller which has the calibration curve of the sensor as a part of its program. A user-friendly display screen shows the concentration of vapours exposed to the sensor.

Detailed explanation for the sensing mechanisms have been provided in our recent publication [1]. Further, since the processes for fabrication are scalable, these can be used for larger platforms as well. In addition, the process can be adopted for batch fabrication which can lead to manufacturing of cheaper and affordable devices. Thus, reliability and cost go hand-in-hand and cannot be considered as independent.

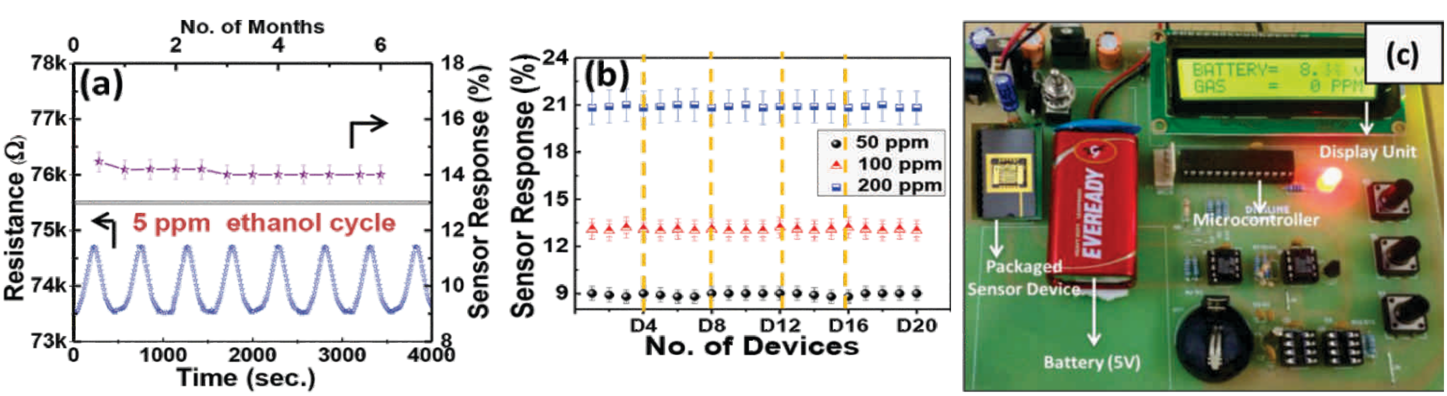

Fig. 4 (a) Stability and repeatability study of TiO_2/PS, (b) Process scalability test and (c) Lab prototype of TiO_2/PS sensor.

Recognition of our R&D activities

Our work, "Selective acetone electrical detection using functionalized nano-porous silicon", Priyanka Dwivedi, Saakshi Dhanekar, Samaresh Das presented at 12th IEEE India International Conference (INDICON), 17-20, Dec. 2015, New Delhi, was recognized as best paper. One of our ideas on fabrication and packaging at wafer scale of DC MEMS switch has been patented [8]. Another pioneering work on acetone sensor has been patented and is being moved for PCT filing [9]. We are currently, trying to contact some companies who would be interested in licensing this product. We are also initiating the integration of MEMS with our sensors for enhancing the sensitivity of the device. This work is anticipated to fetch much improved and interesting sensing results. Our work on breath analyser was highlighted in couple of newspapers, The Pioneer and Amar Ujala in their editions on Dec. 6, 2017.

With continuous efforts of the likeminded research groups in India and across the globe we hope to see a proliferation of affordable and reliable devices that make the quality of our lives better.

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SMART MATERIAL CHARACTERIZATION LAB

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Multi-physics coupled field problems are widely encountered in the design of smart materials such as ferroelectrics, ferromagnetics, multiferroics, shape memory materials, etc. These materials offer multi-functional capabilities that have lured their potential use in sensor and actuator applications. Effective use of such materials in engineering applications is limited by the inadequacy of their theoretical and experimental characterization. The key to guide the use of these materials into novel device applications involves bridging the gap between the synthesis of such materials and their end-user applications, through characterization by experimental, theoretical and numerical means. The challenge lies in bringing the fundamental science and the technology together in this regard. The Smart Material Characterization Lab (SMCL) was set up with this as its key objective. The lab focusses on development of suitable characterization test facilities, evolution of tuning strategies to facilitate device applications, modeling and analysis of the tuned materials and the components, design strategies and considerations for development into suitable applications.

Electrical Setup

Piezoelectric materials have been a topic of scientific research for some decades now with applications ranging from sensors to actuators, MEMs, biomedical and naval owing to its unique coupling characteristics between mechanical and electrical fields. These materials are called 'smart' and intelligent' in the scientific community and are being researched extensively to unfold their underlying physics so as to enable the end-user applications. Piezoceramics like BaTiO3, PZT, PMN-PT, etc. were used for a long time in this regard. But their high acoustic impedance, brittleness, low fracture toughness, toxicity, etc. inhibited their widespread application. This gave rise to smart composites in the form of Macro Fiber Composite (MFC) and Active Fiber Composite (AFC). Recently, 1-3 Piezo Composites are used for these aforementioned applications, in which the piezoceramic rods are arranged parallel with respect to the longitudinal direction in the epoxy matrix. The fiber volume fraction in the 1-3 Piezo Composites play a significant role in their mechanical behavior. The presence of a viscoelastic passive matrix phase also affects the system performance. Thus, it is mandatory to perform mechanical characterization on these smart composites.

SMCL characterizes these materials in myriad ways. Monotonic uni-axial compression, cyclic uni-axial compression, fatigue, creep, creep-fatigue, etc. are some of the tests that are carried out in SMCL. The SMCL is equipped with UTM, Electrometer, Voltage Amplifiers, DAQ Systems, NI Strain Gauge, etc. to mention a few. In SMCL, these smart composites are tested under complex thermo-electro-mechanical loads to mimic the real-life application scenario. The electro-mechanical response of these materials is then studied. In this way, SMCL characterizes these smart composites in order to design the smart systems and structures according to the end-user applications. Figure 1 and Figure 2 shows the electrical and electro-mechanical characterization setup respectively. Measured electrical displacement and strain subjected to large electric filed is shown in Figure 3.

Figure 1. Electrical Characterization Setup

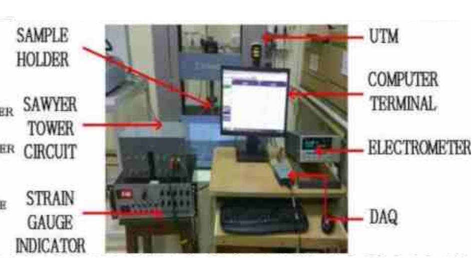

Figure 2. Electro-mechanical Characterization Setup

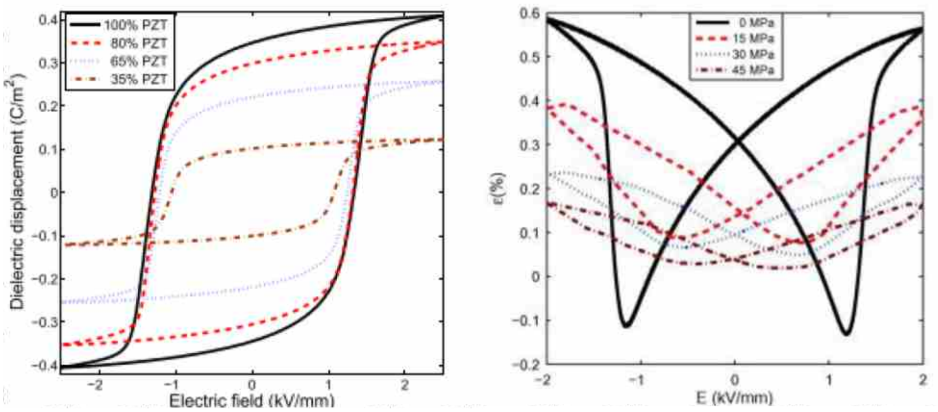

Figure 3. Hysteresis and butterfly loops for different fibre volume fractions of 1-3 piezocomposites

Magneto-Electro-Thermo-Mechanical Behavior

Ferromagnetic materials exhibit a change in length under an applied external magnetic field. This phenomenon is known as magnetostriction, the mechanism for which can be understood by considering the internal structure of the material. The internal structure of the ferromagnetic materials consists of domains that are in general randomly oriented. Under an applied magnetic field, these domains reorient themselves along the applied magnetic field, resulting in strain. Traditional ferromagnetic materials show very low magnetostrictive strains, thus limiting their use in practice. Development of Giant Magnetostrictive Materials (GMM), exhibiting large magnetostrictive strains have made such materials prospective candidates for applications such as actuators, sensors, sonar devices etc.

SMCL focuses on understanding this magneto-mechanical behavior by performing experimental, analytical and numerical investigations. Experimentally, this magneto-mechanical behavior is characterized under a cyclic magnetic loading. The test sample is kept between the two poles of an electromagnet. The electromagnet is driven by a current, which is supplied from two power supplies connected in series. To measure the in-plane strain, a strain gauge is bonded to the surface of the sample and connected to the strain indicator.

Magnetostrictive materials suffer from their inherent brittle nature. Several studies have been performed by researchers in this regard, such as doping with cobalt, nickel etc., to render them ductile. One of the most promising outcomes from these studies, was the development of thin film deposition techniques, where the magnetostrictive strain is manifested as the bending of a film-substrate system. This has attracted several applications in MEMS like micro-sensors and actuators, micro-energy harvesters, etc.

Experimental setups have also been developed for characterization of the deflection of the thin film structures. A laser vibrometer is used to measure this out of plane displacement. The effect of the operating temperature is also experimentally investigated by using a PID controller and K-type thermocouple. Schematics of the experimental setup used for characterization of bulk magnetostrictive materials and the corresponding magneto-mechanical response is shown in Figure 4.

In recent decades, there is also a growing interest in understanding multiferroic magnetoelectric (ME) materials. These materials develop an electrical voltage under an applied magnetic field and vice-versa. This property can be utilized for tuning of the magnetic domains with an electrical signal and vice versa. Such materials facilitate several novel applications such as energy harvesters, magnetic field sensors, information storage devices, etc. SMCL also focusses on understanding the nonlinear behavior of this ME effect, in layered composites of ferroelectric and ferromagnetic materials. A static magnetic field (called a bias field) is applied along with an alternating field of very small orders along the length of the specimen. For a given magnetic bias, the voltage drop across the ferroelectric material is measured by means of a Lock-in amplifier. Hence the voltage obtained is determined as a function of the applied bias field. A schematic of the experimental setup used for measuring ME response and its dependence on temperature is shown in Figure 5. Figure 6 shown the ME and MM response of layered magneto-electric (ME) composite response as a function of temperature.

Composite Material Characterization

Various studies involving smart composites such as Macro Fiber Composites (MFC), piezocomposites, etc, have been undertaken by SMCL. The lab also focuses on the domain of structural composites such as Carbon Fiber Reinforced Polymers (CFRP), Glass Fiber Reinforced Polymers (GFRP) and hybrid composites involving metal-FRP combinations. These materials exhibit various advantages such as high strength to weight ratio, high stiffness to weight ratio, superior corrosion resistance, tailored mechanical properties etc. These advantages have led to a large-scale use of such composites for various applications such as aircraft, naval, automotive etc

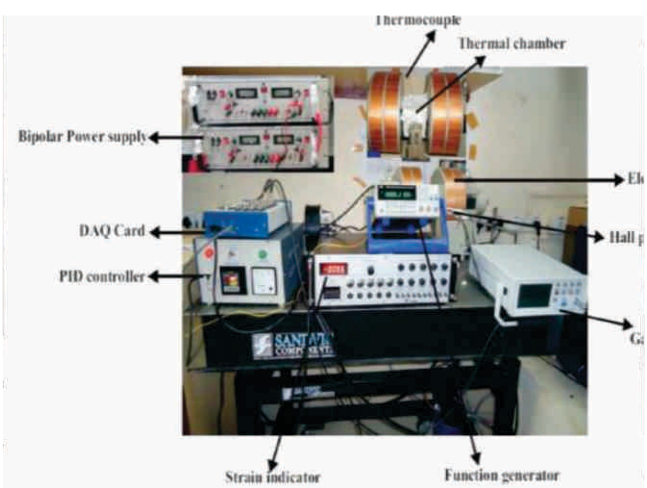

Figure 4. Magneto-Mechanical Characterization Setup

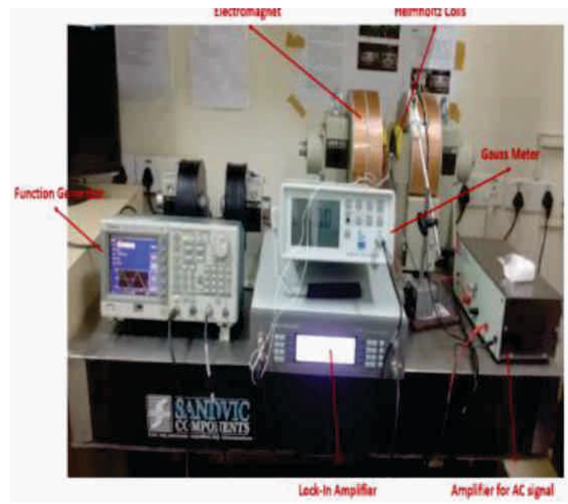

Figure 5. Magneto-Electriccal Characterization Setup

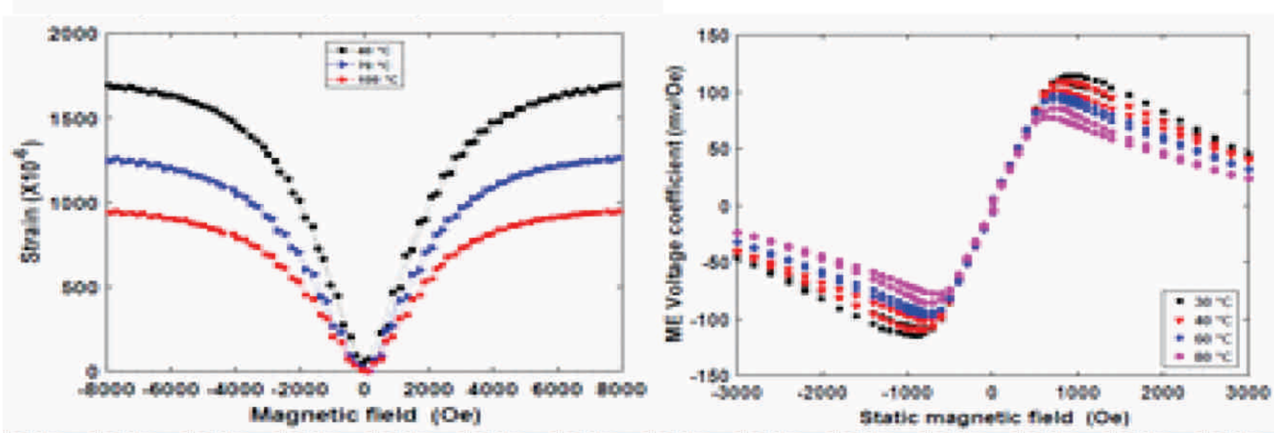

Figure 6. Magneto-mechanical and Magneto-electric responses for different temperatures

SMCL is equipped with the fabrication and characterization facilities required for composite materials. In-house fabrication of laminates is done by Vacuum Resin Infusion and Hand Lay-up techniques. Figure 7a depicts the setup for fabrication of laminates by vacuum infusion technique. The fabricated samples are characterized in accordance with ASTM standards. A unique combination of test facilities is available in SMCL, which includes, a Digital Image Correlation (DIC) setup, UTMs of different load capacities and a Fatigue testing machine. These test facilities enable different kinds of loadings for laminates viz. tensile, compressive, fatigue and bending. Digital Image correlation is employed to obtain the full field strain data during testing. Figure 7b shows the Fatigue testing facility. Apart from experimental investigations, the computational facilities of the lab enable development of models and simulations for different problems.

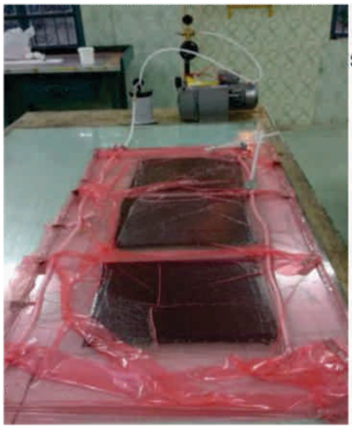

Figure 7(a): Laminate fabrication by Vacuum Infusion

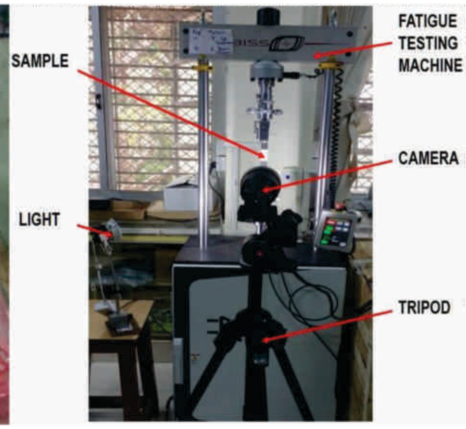

Figure 7(b): Fatigue Testing Setup

Summary

SMCL characterizes functional transducers and intelligent materials both experimentally and theoretically. Testing facilities viz. UTM, fatigue testing machine, electrical setup, electro-mechanical setup, magneto-electro-thermo-mechanical setup aid in measuring the response of smart materials. There are in-house fabrication facilities that aid in preparing structural composites. Recently, SMCL has expanded its horizon by synthesizing core-shell magneto-electric nanoparticles which can be useful for biomedical applications. Synthesis of magnetic nanoparticles and magneto-rheological gel has been carried out in SMCL. Also, silk fibroin samples have been prepared for drug delivery systems, scaffold engineering applications and other biological applications. SMCL has very recently started synthesizing bio-compatible smart hydrogels for similar applications. SMCL is looking forward to bridge the gap between the medical science and materials science so as to find remedies for cancer treatment, brain tumors, Alzheimer's disease, etc. Research is underway in this regard.

Guest Lecture on 'MEMS Devices, Applications and Future'

A guest lecture by Dr.Prosentjit Sen, Asst. Professor at CeNSE, IISc, Bangalore was arranged at M S Ramaiah Institute of Technology , Bengaluru on 20th Feb., 2018. Dr Sen provided a broad overview of MEMS. After a brief introduction to smart sensors, he elaborated on the various applications of smart sensors, ranging from smart glasses, smart homes to smart city. He also opined that these smart sensors are going to be the key component in Internet of Things (IOT) in the technology revolution. He also covered the various aspects of a smart systems consisting of sensors and actuators.

Dr. Sen then talked about MEMS fabrication, elaborating on the process of fabricating a microcantilever. He explained from the basic mask patterning to deposition and development process in order arrive at a free standing micro cantilever. He concluded his talk by discussing the various advantages that MEMS technology has like lower power consumption, smaller foot print and reduced cost.

Researchers' Forum on Micro and Smart Systems March 27 and 28 2018, at CeNSE, IISC, Bengaluru

ISSS in association with CeNSE, IISc., is organizing a two-day symposium for research scholars from across the country working in the pertinent areas. This event is intended to provide an excellent platform for researchers across the country to come together and interact with each other. There will be three Roundtable/ Panel discussion sessions by leaders from Startup Companies, Academic Institutions and Industries on opportunities available for collaborations in terms of building careers in academics or industries and/or pursue innovations towards forming startups. Another highlight of this event will be poster presentation (and a quick pitch talk) by participating researchers in areas such as Physics of Devices, Modeling and Simulation, Smart Materials, Fabrication Technologies and Systems & Applications. In addition to those from IISc, around 30 research scholars / Postgraduate students of institutions/universities across the country have registered for this event and confirmed their participation. We are inviting potential recruiters to this event to connect with the participants for exploiting upcoming opportunities. Apart from special invitees and registered participants, Principals and Heads of departments of academic institutions, and managers and technical leaders from industries are welcome to attend this event and interact with participants.

Nineth ISSS National Conference on MEMS, Smart Materials, Structures and Systems
4 – 6 October 2018, TCE, Madurai

About the Organizers

TCE is organising the **Ninth** edition of ISSS National Conference on **MEMS, Smart Materials, Structures and Systems**, **ISSS-NC9**, at TCE under the aegis of the Institute of Smart Structures & Systems, ISSS, India.

ISSS is a Professional Society that helps to keep pace with the recent advances and give impetus to the emerging Smart technology in India. It organizes a national conference every year on Smart Materials, Structures and MEMS, which has helped to bridge the gaps between the advanced level of technology abroad and the R&D effort in India. Basic aim of this Society is to foster dedicated research in this state-of-the-art/cutting edge technology.

Thiagarajar College of Engineering is one among the several educational, industrial and philanthropic institutions founded by Late. Sri Karumuttu Thiagarajan Chettiar. This 61 years old Institution is a Government Aided autonomous Institution, accredited by NBA, approved by the All India Council for Technical Education and affiliated to Anna University. The college offers 7 Undergraduate, 14 Post graduate and Research programs leading to PhD degree in Engineering, Science and Architecture disciplines.

Scope of the Conference

The ISSS conference will attract researchers, industries and other professionals in the field of MEMS, Smart Materials, Structures & Systems, across the country with special emphasis on Piezoelectric and Shape Memory materials, Actuators, Sensors and Intelligent System Design.

The focus is on the following topics:-

- Modelling and analysis of Micro and Nano Structures
- Design of Micro and Nano components and systems
- Smart Multi functional materials
- Sensors and Actuators
- Micro and Nano System packaging
- Micro and Nano Device Fabrication and Characterization
- Smart material and Structures for
  - Health Care, Energy, Environment, Structural Health Monitoring, Wireless, Thermal Management, DNA Computing, Automotives

Applications: Structural Health Monitoring, Bio MEMS/NEMS, RF-MEMS, Automotive sensors, etc.

Special **Workshops** on related topics are scheduled on 4th Oct 2018(FN) and 6th Oct 2018(FN).

A special session is earmarked for **ISSS Annual Awards** presentation during the conference.

ISSS Students Awards

ISSS UG Award: One Prize Rs.15000 for student project

ISSS PG Award: One prize of Rs.20000 for a student paper based on ME / M.Tech / MPhil / MS / MSc project.

PhD student Award: One Prize of Rs.25000 for PhD student work (near completion/recently completed).

ISSS Young Scientist Award: For outstanding Contribution in the area of Micro & Smart Systems. This award comprises of an ISSS medal, citation and Rs.50000. Max age limit **40 years as on 30 June 2018.**

ISSS Technology Award: For or scientists/engineers who undertake major initiatives to commercialize a product in the area of micro and smart systems. This award comprises of an ISSS medal, citation and Rs.50000.

Important Dates

Submission of Full Paper	: 15th May 2018
Acceptance of Paper	: 10th June 2018
Submission of revised paper	: 15th July 2018
Conference registration	: 31st Aug. 2018

Venue

K S Auditorium,
Thiagarajar College of Engineering, Madurai.

Paper Submission Details

Authors are requested to submit their research findings in about four pages with an abstract highlighting the technical contributions and key results which will enable to finalize the acceptance of the paper.

The full-length conference paper manuscript of your submission in pdf format after embedding all figures, graphics etc should be sent by email to tpcchair@isssonline.in. MS Word template for the final manuscript is available at the conference website. Recommended length of this camera-ready paper is 4 pages.

Log on to: **http://www.isssonline.in/nc9/** for more details for paper format and the conference paper template, etc.

For more details on ISSS Awards, submission templates/ nomination forms, log on to: *http://www.isssonline.in/awards.html*

Nineth ISSS National Conference on MEMS, Smart Materials, Structures and Systems
4 – 6 October 2018, TCE, Madurai

Registration Form

Name:..

Gender:..

Designation:..

Address:..

....

Pin code:..

Mobile No:..

E-Mail:..

DD Details:..

....

Accommodation Required: Yes/No

Place:

Signature

Registration Fee

Student member	: Rs.1000/-
Academics	: Rs.6000/-
Life member of ISSS	: Rs.4000/-

Students of a group more than five: Rs.1000/student

To be an annual member: Rs.6000/- [if already a member extension for one more year]

Registration fee includes conference kit, refreshments during the conference period.

The registration fee has to be paid through DD in favor of **"Convener, ISSS NC9"** payable at **TCE, Madurai.**

Students should enclose a recommendation letter from the Supervisor / HOD along with the Registration form.

Contact Details

Convener: Dr. S. Kanthamani (Dept. of Electronics and Communication Engineering)

9th ISSS National Conference Thiagarajar College of Engineering, Madurai

Tel: 91 – 0452 2482240/2482241

Email: isssnc9@gmail.com

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