R&D NEWSLETTER

Indian Institute of Technology Roorkee

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IIT Roorkee in association with Uttarakhand Jal Vidyut Nigam Ltd., Dehradun and Industry partner M/s MACLEC has developed a floating device based on hydro kinetic turbine which has the advantage of tapping surface velocity of flowing stream to generate electricity. The system is fitted on a floater and anchored at the banks of the stream through steel ropes and is under testing on the Upper Ganga Canal at Roorkee. Prof. R.P. Saini and his team at the Alternate Hydro Energy Center, IIT Roorkee has undertaken this R&D project entitled "Development and implementation of 100 kW surface water velocity driven hydrokinetic turbine VARUN III".

https://www.iitr.ac.in/sric/pages/R&DNewsLetter.html

Recently Registered Research Projects

Molecular and structural analysis of Chikungunya virus capsid protease for antiviral drug discovery

Sponsor: Science & Engineering Research Board (SERB),

Department of Science and Technology

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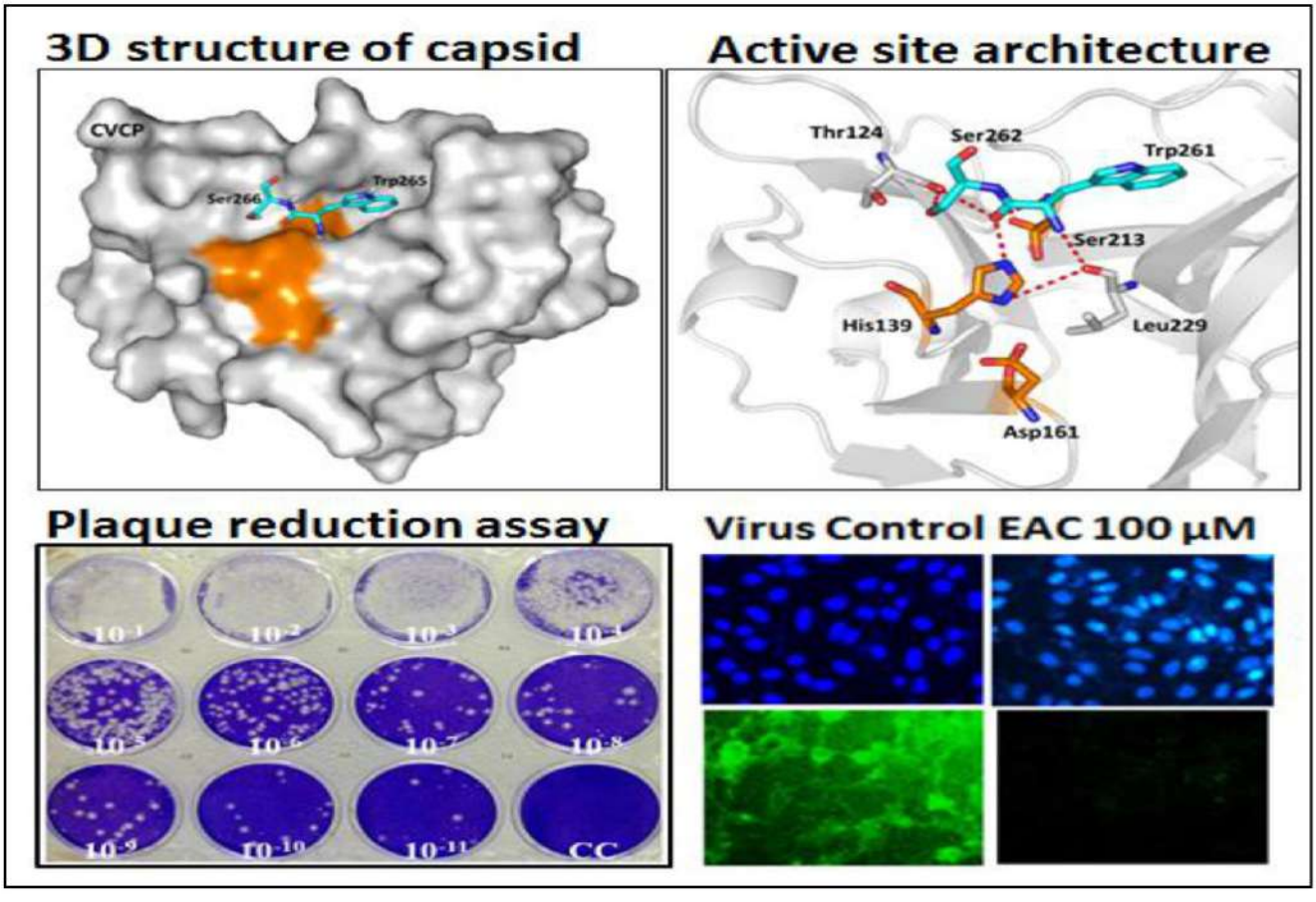
Abstract :Chikungunya Virus (CHIKV) has recently re-emerged in India in the dengue virus endemic areas. Presently, no antiviral drug or treatment is available for these mosquito borne viral infections in the world. Project aims to determine atomic structure of Chikungunya Virus Capsid Protease (CVCP) in free form and its complexes with inhibitor molecules.



Determination of three dimensional structure of Chikungunya virus capsid protease will reveal molecular details of the active site and druggable sites in protein. Virtual screening of compound

libraries using computational biology along with biophysical characterization of hit lead inhibitor molecules and cell based antiviral assays will lead to discovery of novel potential therapeutics for treatment of Chikungunya disease.

Atomic structure will provide conformational details of the active site and details of molecular interactions with the inhibitors at molecular level. In vitro high throughput capsid protease assay and CHIKV replicons for antiviral screening will be developed. Biochemical high throughput (HTP) antiviral screening assays will be used for identification and screening of chemical libraries. Atomic structure of CHIKV protease structure will be used for pharmacophore based virtual screening of compound libraries to identify capsid protease inhibitors. Antiviral potential of structure assisted inhibitors against Chikungunya will be confirmed using engineered CHIKV virus containing a reporter gene. Outcome of the project will be discovery of potential antiviral molecules targeting viral serine protease to combat chikungunya disease.

Evaluation and design of low-cost ground instrumentation with real-time monitoring for the development of landslide Early Warning System (EWS)

Sponsor: National Mission On Himalayan Studies,

Ministry of Environment, Forest and Climate Change

Prof. Rajib Kumar Panigrahi
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Abstract : India has emerged as the hot spot of landslides and associated disaster on global map. The severity and impact of disasters are increasing both in terms of magnitude and frequency causing enormous loss of life, property thus affecting severely GDP and development. Therefore, a comprehensive risk management strategy is needed to reduce the disaster risks. Within a sustainable management of disaster risks, the installation of an early warning system is often a cost-effective risk mitigation measure, and in some instances the only suitable option. Landslide instrumentation and real-time monitoring can provide insight into the understanding of the dynamics of landslide movement. The proposed project aims at the development of a low cost sensor networking and data acquisition system for automated monitoring of landslide for the purpose of early warning, to warn about the threat (based on critical state of the parameters of landslide process) of reaching the catastrophic phase at least 2 hours before the actual occurrence of the event. This will allow to timely evacuate people from hazardous area, and also to inform concerned authority about the approximate time of the process occurrence.

Monitoring Hydro-abrasive erosion and suspended sediment for optimal operation of Hydropower plant

Sponsor: National Hydroelectric Power Corporation Limited

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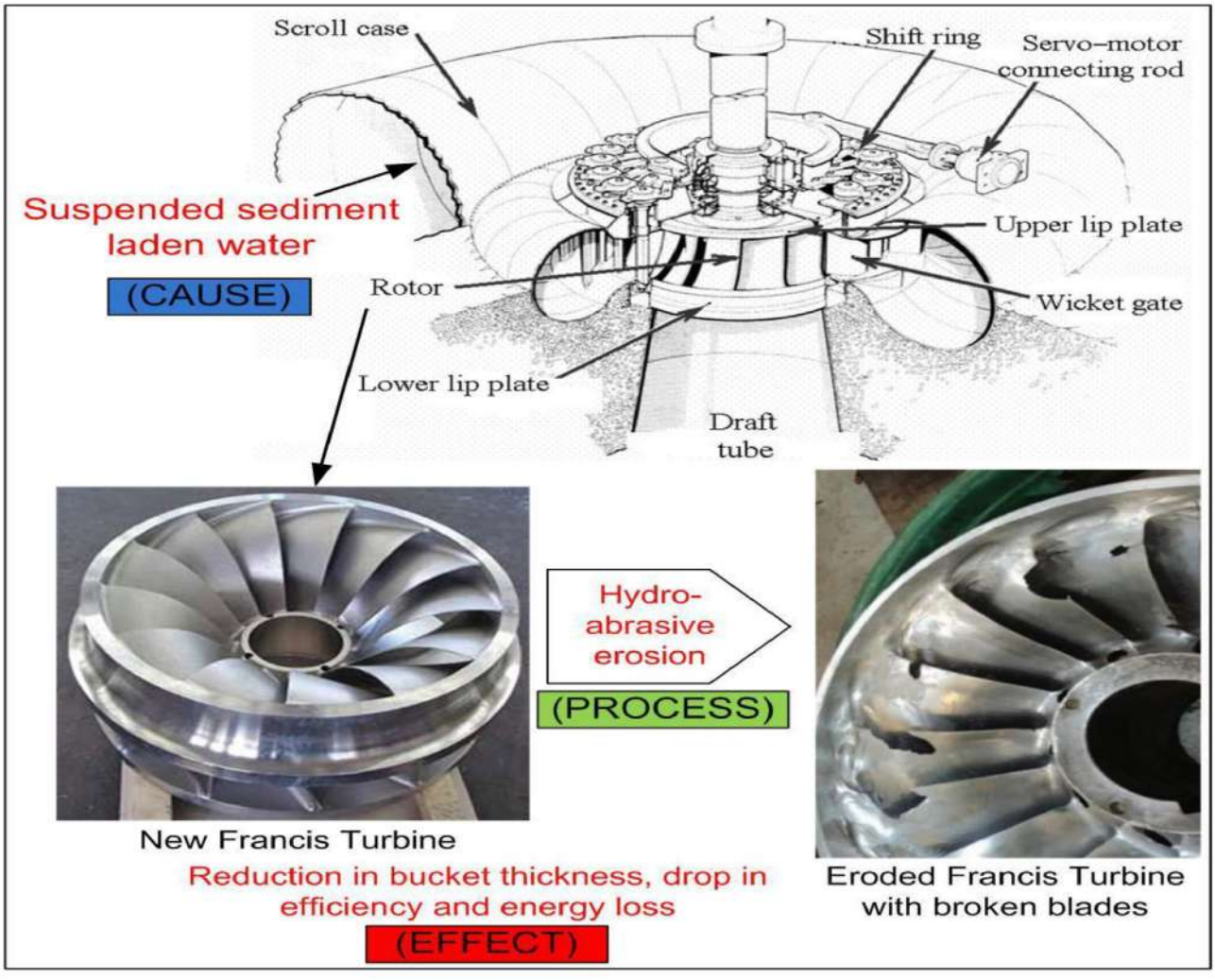
Abstract : The problem of hydro-abrasive erosion due to sediment is becoming more severe for hydropower plants owing to recent increase in energy demand and extreme floods. In high head power plants, even small sediment particles cause critical hydro-abrasion resulting in loss of efficiency and interruptions in power generation.



In this project, online instruments are proposed to measure/capture the variation in sediment parameters along with measurement of hydro-abrasive erosion in turbine and other mechanical components by 3D

scanners. This study shall be very useful for optimum operation of hydropower plants by monitoring sediment, hydro-abrasive erosion and operational strategies.

Development of multi-modal non-invasive imaging technique for compact Computerized Tomography Scanning system using non-linear sparse data algorithm.

Sponsor : Science & Engineering Research Board

Prof. Mayank Goswami

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Abstract : Non-invasive and non-destructive (NDT) imaging provides results, in 3D, that cannot be seen in real-time, without destroying/perturbing the environment under investigation. This proposal is one step towards establishing facilities at IIT Roorkee for NDT Imaging. NDT/CT scanning systems are costly, heavy and possess significant possibilities of radiation exposure. The primary objective is to develop multi-modal NDT technology. Secondary aim is to achieve cost effectiveness, enhancement in accuracy and reliability in a compact and customizable system for industrial applications. Non-linear modeling is the projected pathway. Long term goal is indigenous technology development of advanced versions.

Assessment of the mechanism of actions of some selected homeopathic preparation for their role in the prostate cancer

Sponsor: Ministry of AYUSH, New Delhi

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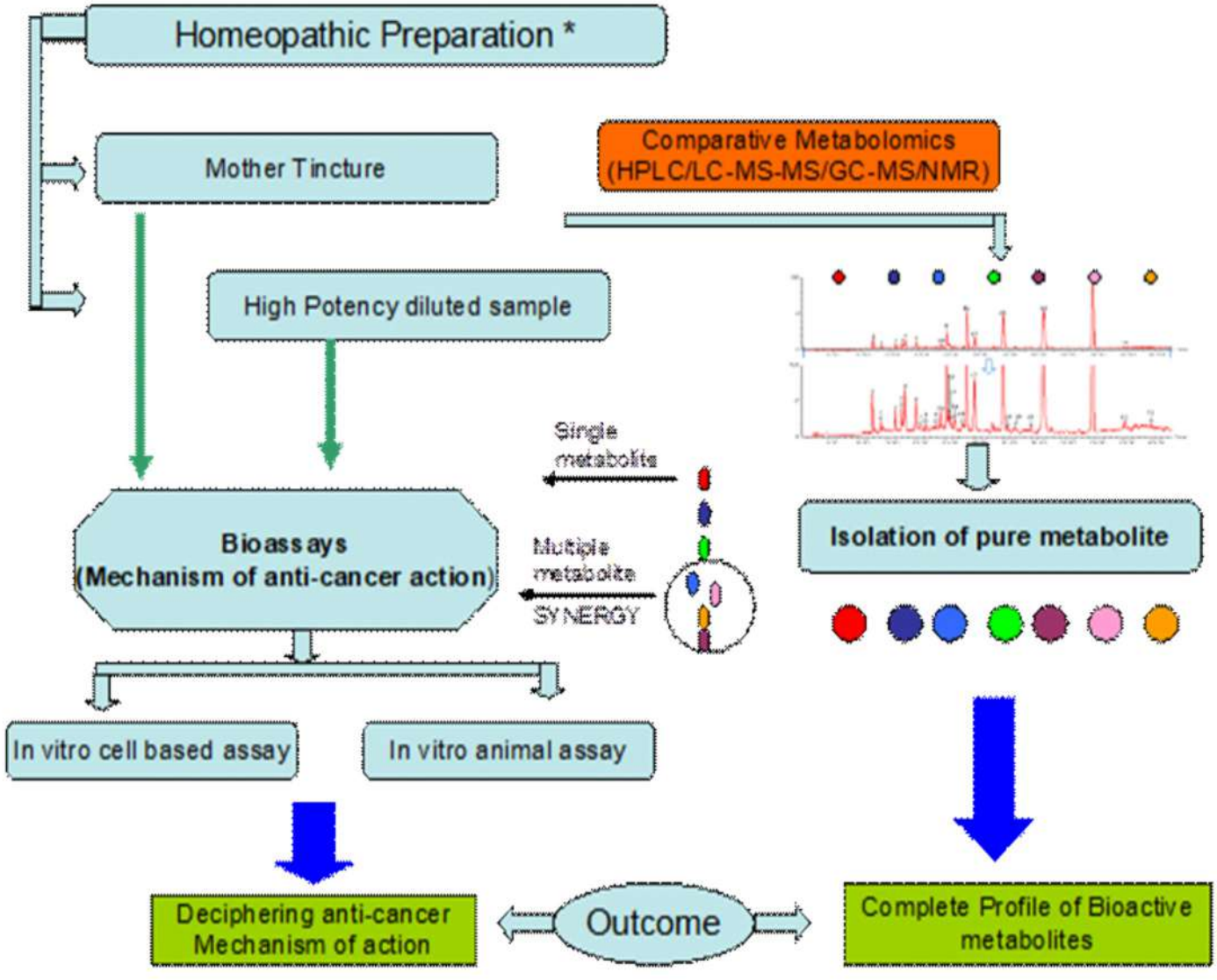
Abstract : Despite several reports of excellent clinical efficacy of homeopathic medicines in treating a several deadly diseases, till date the complete scientific validation and standardization of homeopathic drugs in terms of fingerprinting of bioactive metabolites, toxicity, shelf-life, dilution effect and curative mechanism of actions against a particular disease target remains largely unknown. Homeopathic-based cancer treatment has great promise, given the exceptional safety of the treatment and the relatively frequent observation of beneficial clinical effects. In this project, based on recent clinical and literature evidence, we propose to demonstrate the scientific validation of selected cancer curing homoeopathic

drugs in terms of metabolic profiling at various dilutions and their corresponding biological activities in collaboration with Central Council for Research in Homeopathy (CCRH), New Delhi.In spite of its widespread use in India and other western countries as medicine, selected homoeopathic drugs have been poorly characterized and significant gaps exist in the scientific understanding of its active constituents and mechanism of curative actions, thus restricting its commercial opportunity. This research project aims to bridge this gap of knowledge by detailed analysis of some selected cancer curing homeopathic medicines in terms of deciphering their bioactive constituents using metabolomics approach and understanding their mechanism of actions at cellular level. The project consortium involves basic researchers, homeopathic clinicians and pharmacologist involved in homeopathic research.



Correlation of homeopathic medicines with their dilution effects in terms of composition and actions

Development of corrosion resistant hydrophobic coatings for the protection of structural components under saline water applications

Sponsor: Defence Research and Development Organisation (DRDO)

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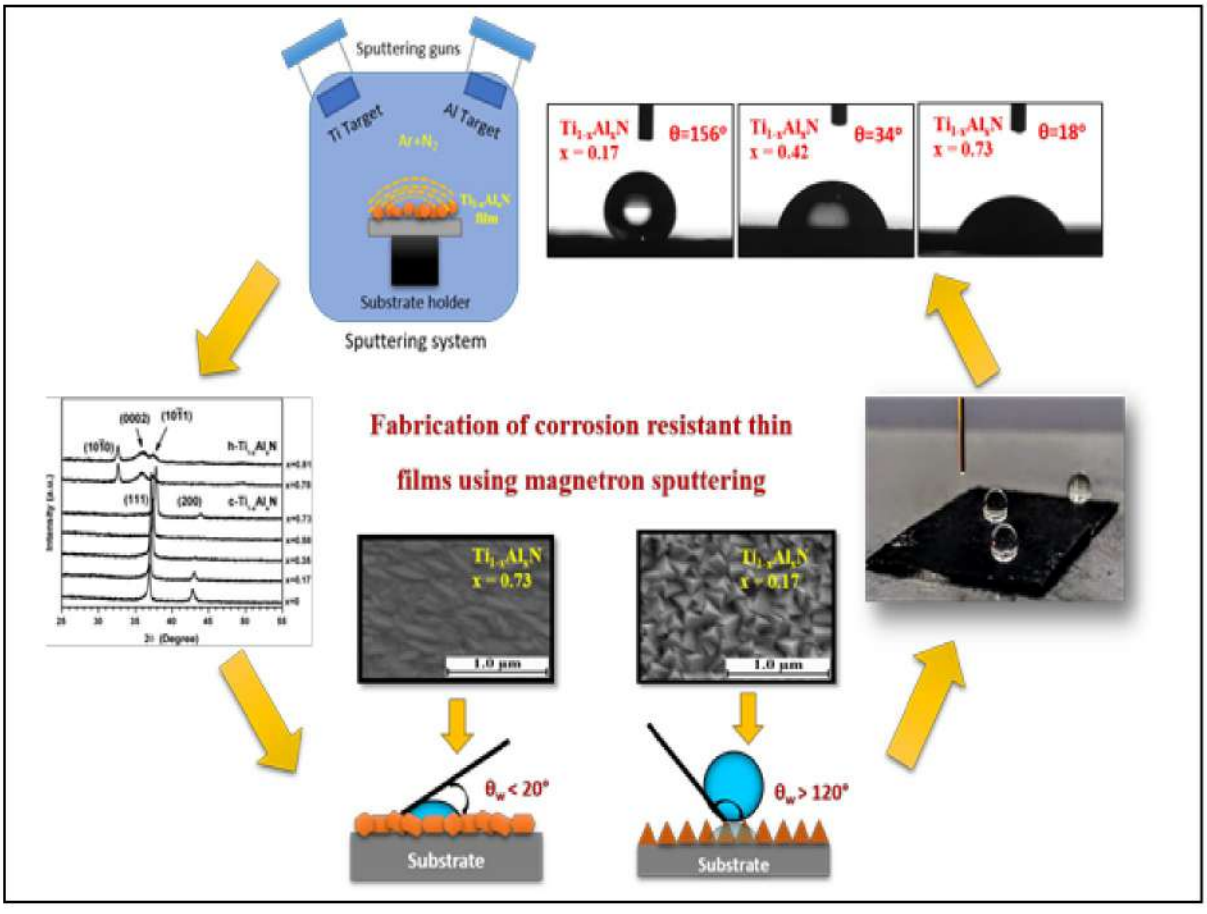
Abstract: There are different ways to control corrosion including inhibitors, coatings, applying anodic/cathodic protection and enabling proper design. Surface treatment is an effective technique to solve the problem, which includes chemical conversion coating, electroplating and electroless plating, physical vapor deposition and so on.



Among these surface coatings by physical vapor deposition technique especially sputtering is a simple and cost-effective method and has been increasingly used in a wide range of applications. The thin film coating acts as a physical barrier to protect the metal from corrosive environment. The protective value of such coatings depends on continuity and thickness of coating. Metal oxides could provide more robust coating materials because their electron configuration makes them intrinsically hydrophobic. Metal oxide and oxynitrides coatings have been fabricated using the sputtering process. These coatings have high

hardness, toughness, hydrophobicity and optical transparency in the working region.

In the frame of above research area, nanostructured thin films have been fabricated by our research group for distinct applications. Currently, our group is working on hydrophobic and corrosion resistive coatings for the protection of structural components used under saline water for strategic applications.

Anaerobic co-digestion of therochemically pretreated organic fraction of municipal solid waste and sewage sludge: Effect on process performance and microbial community development

Sponsor : Department of Biotechnology (DBT)

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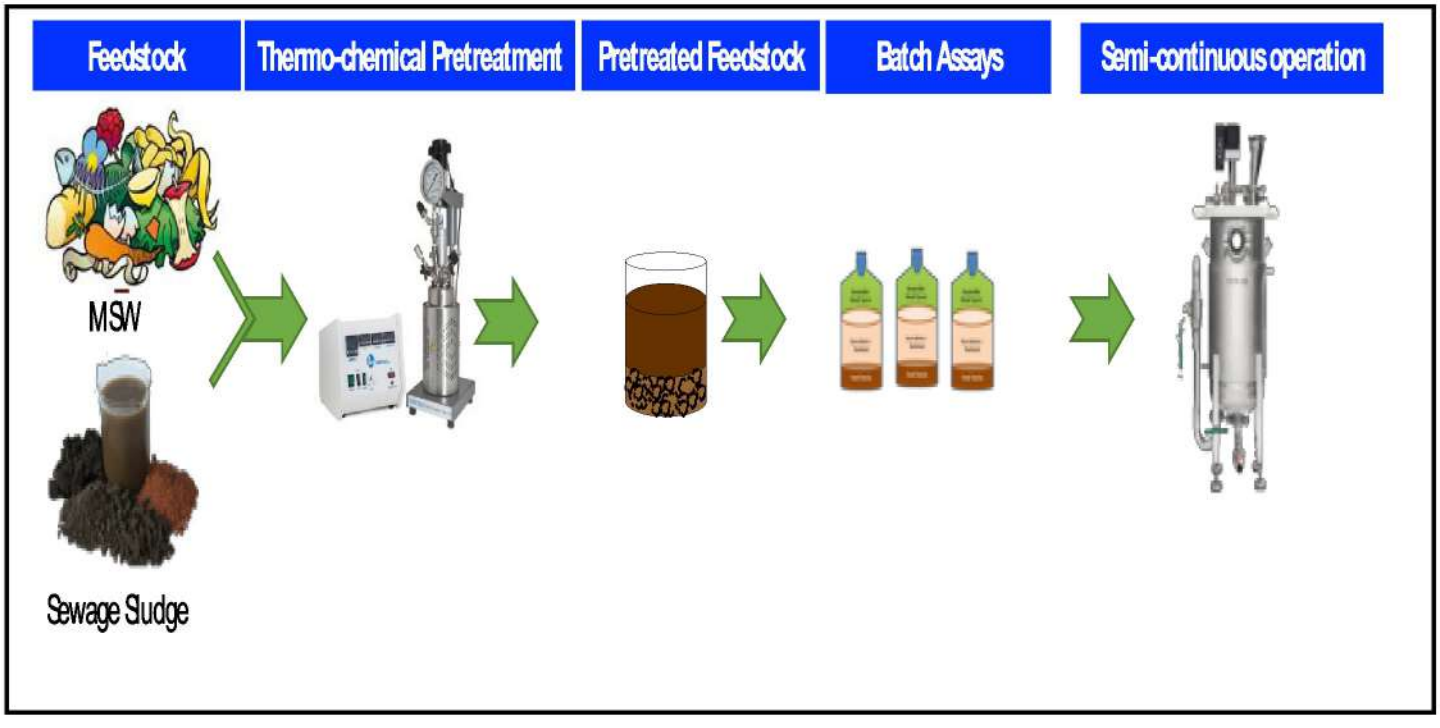
Abstract : The anaerobic co-digestion of organic fractional of municipal solid waste (OFMSW) and sewage sludge (SS) and use of different pretreatments to enhance the organic matter solubilisation and subsequent biogas generation can serve the twofold objectives:



1) management of two problematic wastes, which are posing threat to soil, air, water resources and public health, and 2) energy rich biogas recovery, which may fulfill present and future energy requirement and thus reduce the dependency on rapidly exhausting fossil fuels reserves. Against the backdrop of sustainability and closing of material and energy cycles, this project contributes to the more efficient conversion of waste biomass to renewable energy and, furthermore, increases the potential to reduce the global CO_2 emissions and attributed global warming.

Devlopment of high quality nanostructured piezoelectric thin films and multilayers for MEMS devices

Sponsor: Defence Research And Development Organisation (DRDO)

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Abstract: High quality Piezoelectric thin films integrated on silicon substrate are attractive for many acoustic and optic applications: micro-electromechanical (MEMS) and nano-electromechanical (NEMS) devices, high-power and high-temperature electronic devices and optoelectronic devices at the ultraviolet region. MEMS devices based on piezoelectric materials take advantage of the high energy transduction that scales very favorably upon miniaturization. With the advancement of MEMS technology employing PZT thin films for micro actuator, energy harvesters, sensors, and piezoelectronic applications a quest for the best possible film is going on.

Therefore, it is very important to study the preferential orientation of piezo films with different components and substrates. Besides this, the main requirement for all Piezo MEMS application is that the film can be deposited at low temperature. This is easily patterned with using conventional photolithographic technique and compatible with CMOS, a key consideration for on-chip integration of electronics with MEMS devices.

Under this proposed research plan, we will optimize the oxide and Nitride based piezoelectric thin films using site-engineering concept to get best film crystallinity, high electrical resistivity, high hardness, high Curie temperature, good piezoelectric response, low residual stress and high chemical stability, low dielectric constant & best acoustic properties with high power generation capabilities which will be suitable for electronic devices especially MEMS & Acoustic Resonators fabrication.

DC And RF Magnetron Sputtering System

Investment in knowledge & innovation and Its' impact on knowledge cluster and network in Indian cities

Sponsor: Department of Science & Technology (DST)

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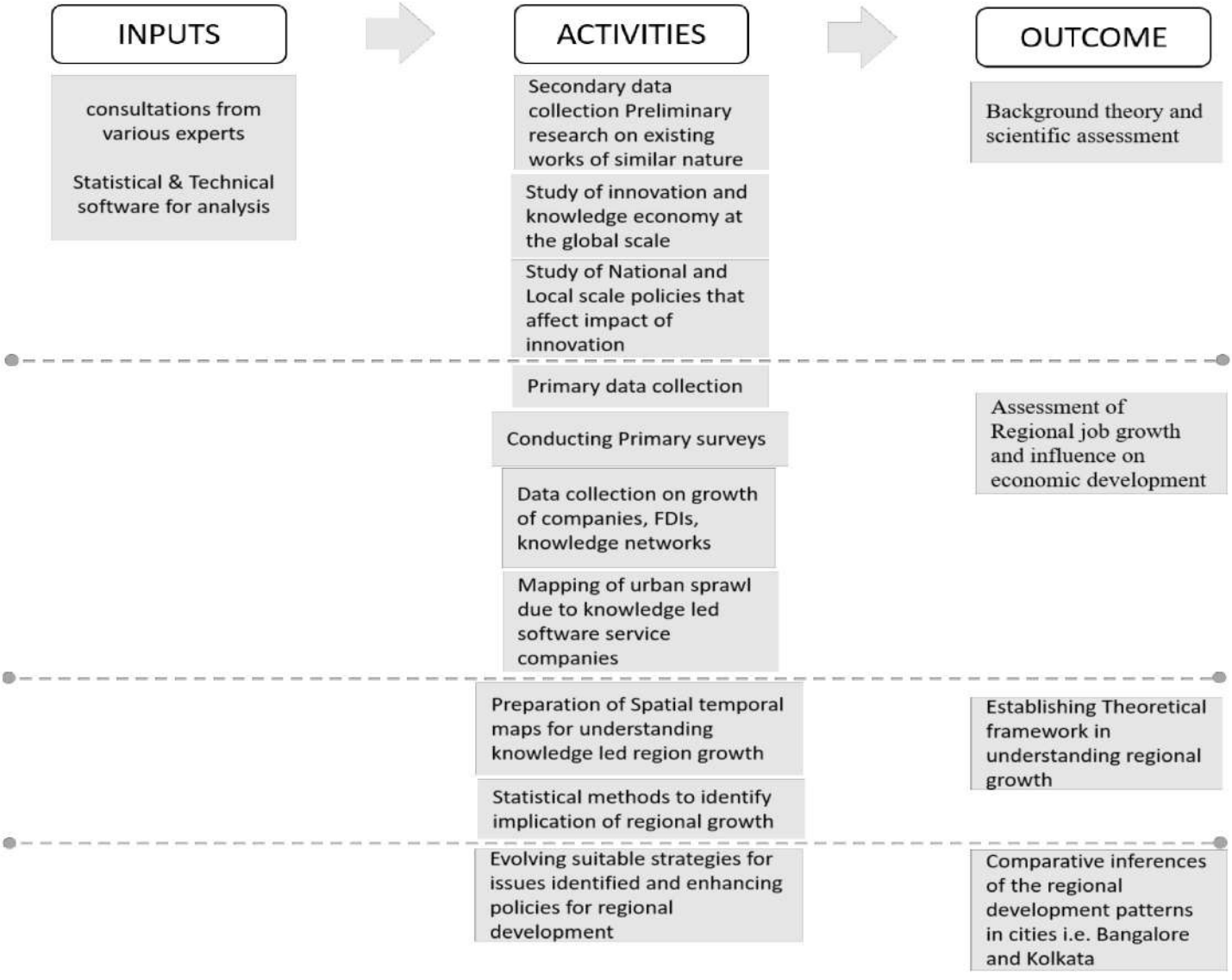
Abstract: Traditionally land, labour and monetary capital was considered as the major inputs for economic production. Knowledge as an important capital was recognised after the 1970s when the semiconductor industry in the U.S. was overtaking the traditional inputs for economic production and helped in evolving the Regional development aspects in spatial planning. Globalisation has created an impetus in the evolution of knowledge-based economy from the core developed countries to the peripheral developing countries. Networks between universities, research institutions and industry entrepreneurs would help in spill over of knowledge within a knowledge cluster. Government plays a supporting role that would not only help in factor production of human resources but also encourage entrepreneurship through policy interventions.



Texture impact on dispersion and attenuation behavior of seismic rock properties in partial to fully saturated carbonate reservoirs

Sponsor: Oil & Natural Gas Corporation (ONGC) Ltd.

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Abstract : In exploration geosciences, the ability to detect and detail the areas of changing reservoir physical properties is key to the success of exploration and development projects for hydrocarbon exploitation or for that matter in understanding the rock stability for sequestering major Green House Gases such as CO_2. The changing rock physical properties may originate from a displaced fluid and may also be significantly affected due to alterations in the rock matrix itself as a result of rock-fluid interactions. There are other parameters such as texture (heterogeneity) of the rock, mineral content of the rock and that of the pore fluid, which upon being considered as one of the variable in scheme of things

may increase the complexity to invert the rock and fluid properties form the measured field data. Cadoret et al. (1998) and Sharma et al. (2013) show that elastic response in complex reservoirs such as carbonate formations is significantly affected due to the heterogeneous saturations that gets developed during inefficient reservoir sweep (Figure 1). Therefore the need is to develop a good understanding of responses by designing forward problems where a clear quantification of rock and fluid inputs is available beforehand. This example shows that characterization in carbonate rocks can clearly become more challenging with introduction of heterogeneous fabric texture. The somewhat exhaustive nature of the variable parameters are shown in Figure 2. In this project, the main objective is to create and interpret these forward model templates and to determine an Equation of State (EoS) that would be used to predict the elastic and viscoelastic behavior in the complex reservoir formations. Figure 2 is the schematic presentation about the variation in value of an elastic property estimation w.r.t the frequency of investigation (Batzle et al. 2006) and the state of fluid saturation and its free movement inside the reservoir. Variation in estimation of elastic properties with change in frequency is known as dispersion and is attributed to the intrinsic attenuation (1/Q) of the medium (Spencer, 1981; Kumar, 2003; Batzle et al., 2006). It is essential to understand the non-linear properties in these visco-elastic materials in order to understand the field application of the seismic data.

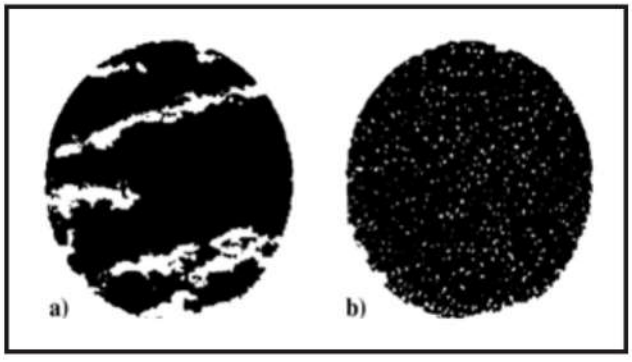

Figure1. X-ray microphotographs of the saturation maps of Brauvilliers limestone. White area corresponds to gas bearing zones. (a) Saturation obtained by drying sample with initial Sw= 92%. (b) Fully water saturated sample (from, Cadoret et al., 1992).

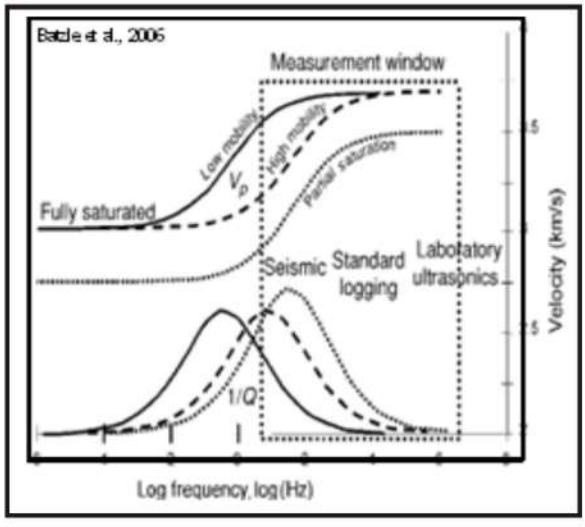

Figure2. Sketch of the general frequency dependence of the compressional seismic velocity and the associated attenuation (1/ Q) for oil-saturated (with low and high fluid mobility) and partially saturated sedimentary rocks.

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