



**TIFR Centre for Interdisciplinary Sciences, Narsingi,  
Hyderabad 500075**

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**Seminar**

**Ferroelectric materials for cooling and energy applications**

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In this talk, I will focus on two distinct applications based on properties of ferroelectric materials. First, I will discuss electrocaloric (EC) refrigeration – a candidate for solid-state cooling that exploits electric field-driven temperature/entropy changes near ferroelectric phase transitions. There has been a resurgence in this field since the discovery of giant EC effects (~12 K) in ferroelectric thin films, prior to which EC temperature changes were restricted to a few Kelvin in bulk ferroelectrics. I will discuss novel EC measurement schemes, including scanning thermal microscopy and infrared thermometry, and thermal models that predict impressive cooling performance that may be achieved using EC multilayer capacitors. I will also compare ceramic and polymer ferroelectric materials showing large EC effects.

Second, I will present some exciting new results on the vibrational energy harvesting performance of ferroelectric polymers based on the piezoelectric effect. Piezoelectric materials are capable of directly generating electrical power for autonomous wireless and electronic devices from ubiquitous mechanical vibrations. In particular, nanowires of organic piezoelectric polymers are attractive for use in vibrational energy harvesters as they are flexible, lightweight and sensitive to small vibrations. Piezoelectric poly(vinylidene fluoride-co-trifluoroethylene) [P(VDF-TrFE)] nanowires have been fabricated using a simple and cost-effective template wetting technique which can be incorporated as-grown into energy harvesting devices, without the need for annealing or electrical poling. A simple energy harvesting devices comprising a single array of aligned P(VDF-TrFE) nanowires has been demonstrated as capable of lighting a commercial light emitting diode. The template-grown polymer nanowires offer a scalable means to achieve high-output vibrational energy harvesters with the potential to provide power for electronic devices in remote, dangerous or inaccessible locations including devices that are imbedded within structures.

***Tuesday, Jan 7<sup>th</sup> 2014***

***11:30 AM (Tea/Coffee at 11:15 AM)***

***Seminar Hall, TCIS***