Shrinking Ferroelectrics in Memories, Microwave Tunable Circuitry, and Robotic Applications

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Ferroelectrics and polar materials in general make essential components in diverse applications such as active vibration damping and ultrasound medical imaging. In thin film form, ferroelectrics are used in non-volatile random access memories (FeRAMs) and as sensors and actuators in Micro-Electro-Mechanical Systems (MEMS) and are being developed as components for reconfigurable microwave electronics. The drive for down scaling in those fields imposes the development of strategies and methods for production of highly-performing 'tiny ferroelectrics', be it thickness wise or lateral size reduction. This is the subject of my seminar in which some of the recent research results from the Ceramics Laboratory of the EPFL will be presented. Firstly, the concept of ferroelectric nano-lithography and its realization on semiconductor heterostructures will be shown as a possible way to reduce the size of ferroelectric memories. Next, production of ordered arrays (towards nano-composites) of tunable ferroelectrics will be shown to be an effective way to enhance tunability and reduce dielectric losses at high frequencies. Thirdly, production of anisotropic piezoelectric particles (nano-rods and nano-wires) will be described and several aspects of their structural and functional properties presented.