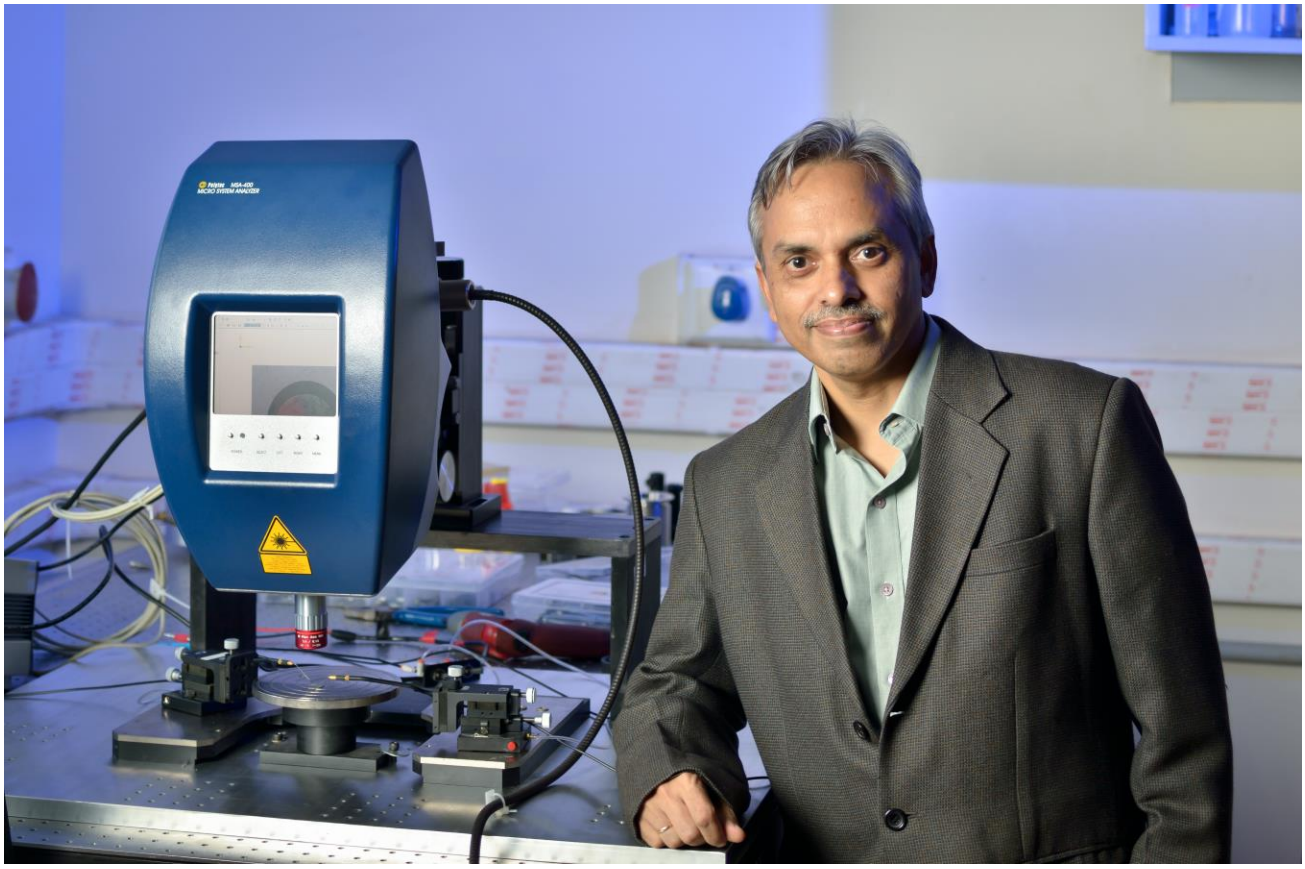
COMPILED AND EDITED BY THE **CONNECT TEAM** BASED ON INPUT FROM THE FEATURED **RESEARCHERS**

RUDRA PRATAP (CHAIR AND PROFESSOR, CENTRE FOR NANO SCIENCE AND ENGINEERING (CeNSE))



(MANOJ SUDHAKARAN)

How nanoengineering is changing our world

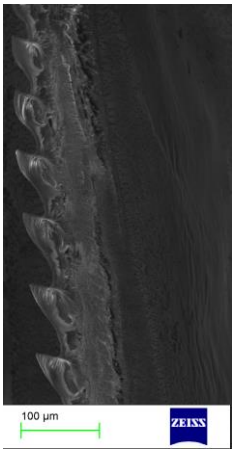
Rudra Pratap studies structures that are so small that they have properties very different from those in the macro-world. The current focus of his group is to understand the dynamics of micro and nanoscale mechanical structures, such as beams, plates, membranes etc, commonly used in Microelectromechanical Systems (MEMS) and Nanoelectromechanical Systems (NEMS) devices.

Because of their size, these mechanical structures have very high natural frequencies (ranging

from a few KHz to a few GHz). At such frequencies, it is important to understand certain phenomena that are very different at macroscales. One such example is the mechanism of energy dissipation. Its understanding at nanoscales will help in realizing devices with incredibly sharp resonant peaks never achieved before in mechanical devices. Therefore, Pratap's lab is studying mechanisms of damping in MEMS/NEMS devices and developing dynamic sensors that find applications in acoustics, ultrasonics, inertial navigation and medical diagnostics.

With the help of collaborators, Pratap's group is vigorously pursuing research in controlled electromigration for material transport at nanoscales. They have invented a new technology called *Electrolithography*, capable of nanoscale patterning and pattern transfers on any substrate using an inexpensive patented process. They now aim to develop this technology for commercial use.

Pratap's team is also interested in exploring the world of tiny transducers that insects use. In collaboration with insect biologists, they are seeking to understand the design of transducers involved in cricket song production. They have developed a model of singing field crickets that reveals how natural selection has ensured that different cricket species have evolved distinct frequency bands using an elegant scaling law for their wing design (crickets produce songs by rubbing their wings against each other). This finding may find use in designing new MEMS speakers.



Top left: A field cricket

Top Right: The harp, a resonator embedded in the wing that acts as a loudspeaker

Left: Set of micro teeth that form a file on the underside of one edge of the harp, responsible for converting low frequency wing stridulation into a high frequency impulse train that excites the harp

(Courtesy: Rudra Pratap)

Rudra Pratap with his team (MANOJ SUDHAKARAN)