HEMI Seminar

Active Periodic and Non-Reciprocal Phononic Structures for Control of Ultrasonic Wave Propagation

Arup Neogi
Professor, Dept. of Physics
University of North Texas

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Non-reciprocity in acoustic wave propagation through a phononic crystal can be achieved using asymmetric scatterers in a phononic crystal. The passive non-reciprocity is observed due to the simultaneous violation of the P and T symmetry along the direction of the propagation of the sound waves. These non-reciprocal structures can be made active to achieve multifunctional acoustive periodic structures. Active control of phononic structures such as phononic crystal based mirrors, filters, and lens has been achieved using electromagnetic radiation of the medium or mechanical actuation of the individual scatterers. Hybrid phononic structures with radio-frequency susceptible thermo-sensitive polymer has been used to modify the ultrasonic propagation. Using the anomalous change in elastic properties and sound velocity in the polymer, tunable filters or ultrasonic lens has been realized. Tunable focusing of ultrasonic waves has also been achieved by the mechanical control of nonreciprocal gradient induced differential dissipative (GIDD) phononic structures. The active mechanical actuation of the individual asymmetric scatterers of a GIDD device can result in its transformation from an acoustic conductor to an acoustic isolator. The role of roughness in the transmission of acoustic signal will be discussed.

Arup Neogi is a University Distinguished Professor of Physics at the University of North Texas. He earned his Ph.D. degree in Electrical Engineering from Yamagata University Japan in 1999 and a M.Sc. degree in Applied Physics from R.D. University, India. He has been a Senior Research Fellow of the National Research Council at the Army Research Laboratory/Duke University from 2000 to 2002. He was a NEDO Fellow at Femtosecond Technology Research Association, Tsukuba, Japan and a Fellow of Japan Society for Promotion of Sciences. He has authored over 250 research publications and his current research interests are in the area of Nanophotonics, Ultrafast and Ultrasound Spectroscopy. He currently leads the NSF Emerging Frontier Research Initiative on Nonreciprocal Phononics at the University of North Texas.

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