Indian Institute of Technology Kanpur

INSTITUTE LECTURE SERIES

November 10, 2023 (Friday) | 6.00 pm | L - 17

Speaker: Professor Jagdish Narayan

Talk Title: A New Frontier in Materials Science for Advanced Technology

About the Speaker

Prof. Narayan did his B. Tech from IIT Kanpur in 1969 and subsequently did his MS and Ph.D. from UC Berkeley in 1970 and 1971 respectively. He is internationally known for his pioneering contributions in laser annealing and pulsed laser deposition, defects and interfaces, domain matching epitaxy for novel thin-film heterostructures across the misfit scale, and creation of new materials with unique properties. His research on defects and interfaces focuses on the structure-property of thin-film heterostructures, needed for improved and novel solid-state devices. His most recent research pertains to diamond and c-BN based thin film heterostructures for next-generation high-power and high-frequency devices, including the discovery of Q-carbon and Q-BN and direct conversion of carbon into diamond and h-BN into c-BN at ambient temperatures and pressures in air. He has published over 500 archival journal papers, 48 US Patents, and 9 edited books, which have over 35,000 citations.

Prof. Narayan has received the highest honors from the State of North Carolina (North Carolina Science Award), O. Max Gardener Award, and North Carolina State University (Holladay Medal). His other honors include NAE, NAI and NAS-I, ASM International Gold Medal, Acta Materialia Gold Medal, TMS RF Mehl Gold Medal; and Fellow MRS, Fellow APS, Fellow AAAS, Fellow TMS, and Fellow ASM International. He is also the winner of six R&D-100 Awards, widely recognized as "Oscars of Innovation". Prof. Narayan is the recipient of the IITK Distinguished Alumnus Award of 1998.

Abstract of the Talk

Discoveries of new phase of silicon (Q-silicon), carbon (Q-carbon) and BN (Q-BN) and direct conversion of carbon into diamond and h-BN into c-BN at ambient temperatures and pressures will be presented which would open a new frontier in ambient quantum computing, nanosensing, high-frequency and high-power devices, high-power lithium and sodium ion batteries, and biomedical applications. Amorphous carbon or nanocrystalline h-BN films are melted in a super undercooled state by nanosecond laser irradiation, and quenched into diamond (or Q-carbon) and h-BN into c-BN (or Q-BN), depending upon the degree of undercooling. A parallel process by ion irradiation to convert amorphous carbon into Q-carbon has been discovered. Using these processes diamond and c-BN can be formed as NV nandiamonds, microdiamonds, nanoneedles and microneedles, and large-area single-crystal films. These phases can be doped with both n- and p-type dopants, opening a new frontier in diamond and c-BN electronics. Undoped Q-carbon is ferromagnetic and upon doping with boron, it turns paramagnetic and exhibits record BCS high-temperature superconductivity. This system provides an ideal platform for RT superconductivity. An epitaxial <111> NV nanodiamonds of uniform size (4-10nm) has been created which can be driven electronically and photonically, for applications ranging from biosensors to quantum computing. This discovery of high-temperature superconductivity in B-doped amorphous Q-carbon shows that non-equilibrium synthesis technique using super undercooling process can be used to fabricate materials with greatly enhanced physical properties.

All are cordially invited to attend

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