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PERSPECTIVE ON CURIOSITY– DRIVEN INNOVATIONS AND MY CONTRIBUTIONS TO ADVANCED MATERIALS FOR AEROSPACE, ENERGY, ELECTRONICS, AND QUANTUM SYSTEMS

Dr. Raj Singh

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BIO Dr. Raj N. Singh is a Regents Professor and Member of the National Academy of Engineering (NAE). He served as a founding Head of School of Materials Science and Engineering, Williams Companies Distinguished Chair Professor, Director Energy Technologies Programs at the Oklahoma State University (OSU). He received his Sc.D. degree from Massachusetts Institute of Technology in Materials Science and Engineering. He worked at Argonne National Laboratory, GE-R&D Center and University of Cincinnati before joining OSU in 2012. Dr. Singh has been recognized for his engineering leadership through his scholarly activities (260 journal articles, 95 referred proceeding/reports, and 282 oral/invited presentations), pioneering inventions of MI composite processing technology leading to commercialization (28 granted patents), for graduating 36 students with MS and PhD degrees and through numerous professional awards in recognition of his engineering leadership such as Member of National Academy of Engineering (NAE), National Academy of Inventors (NAI), Rishi Raj Medal for Innovation and Commercialization from American Ceramic Society, Albert Sauveur Achievement Award of ASM International, Regents Professor (OSU), Fellow of AAAS, Fellow of the ASM International, Fellow of the American Ceramic Society, Fellow of Graduate School (UC), Whitney Gallery of Technical Achievers GE-CR&D, Publication Awards GE-CR&D; Patent Awards GE-CR&D: Bronze, Silver, and Gold Patent Medallions. He also serves as member of editorial boards of 5 international journals.

ABSTRACT The Discovery of novel materials displaying unique phenomena and properties are the hallmark of modern science, engineering, and technologies such as those potentially useful for applications in Aerospace, Energy, Electronics, Quantum devices, and Smart systems. My contributions to each of these technologies were curiosity-driven that led to innovations and discovery of new phenomena and related advanced materials. These included novel materials and their processing and manufacturing of fiber-reinforced ceramic composites for jet engines, electrodes and solid electrolytes for high energy density batteries and fuel cells, self-repairing high-temperatures seals for fuel cells, and ferroelectric ceramics displaying large strain capability for smart systems. Our current research is focused on processing and properties of diamond as a fascinating material due its wide band gap, optical transparency, and high thermal conductivity rendering it an ideal wide band gap semiconductor for quantum systems and thermal management of electronics. Specifically, diamond containing nitrogen-vacancy (N-V) defect centers displays unusual characteristics making it attractive for quantum devices and sensing applications. We are addressing current challenges by developing processing approaches to synthesize diamond single crystal arrays containing only one type of N-V defect centers by Microwave Plasma Enhanced Chemical Vapor Deposition (MPECVD) and studying related photoluminescence properties for quantum devices. This presentation will provide a brief perspective on some of the innovations on advanced material that have led to major impacts on science and technology of related industries and systems.