Design and Manufacturing of Photonic Smart Coatings for Optoelectronic Applications

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Abstract: The photon management on a glass substrate (SiO2) has attracted significant interest in the opto-electronic industry. The one-dimension photonic crystals show significant promise for the photon capture for optoelectronic applications. The periodic dielectric layers of the transparent nano-layers can form a one-dimensional photonic crystal in the form of Bragg reflector. The properties of Bragg reflection are well-known and studied extensively in optoelectronic applications, such as DBR and VCSEL laser and fiber optic applications. The Photonic Smart Coatings developed with one dimensional photonic crystals and plasmonic nano-structures can be used to manage the photon wavelengths in the region of interest while harvesting the scattered photons using photonic crystal layers towards the optoelectronic sensors. The application of nano-optical photonic coating can be in the enhancement of efficiency of PV cells, management of thermal properties of architectural glass for energy savings and to improve quantum efficiency of the optoelectronic devices. The presentation provides a scalable manufacturing approach for the design and development of photonic crystal coatings on a glass substrate using magnetron sputtering process.

The broader impact of Photonic Smart Coating (PSC) will be to significantly improve the power output of photovoltaic solar cells and sensors to accelerate generation of clean power. This photonic spectrum shaping technology can be applied in numerous industries including Solar Panels, Optics, Imaging, and Display devices generating large number of high paying hi-tech jobs across USA. The manufacturing of PSC will enable development of skillset for human resources in USA for growing economy of Photonics, Imaging and Cleantech. In addition to PSC coatings, the associated innovations in the manufacturing of multi-layered nano-optical coatings will have major impact on advanced manufacturing of photonic enhancement to photovoltaic panels, architectural glass, and opto-electronic devices. The developing countries in Africa, Asia, South America suffering from fluctuations in the cost of power generation will immediately become prime candidates for the use of PSC solar panels. Wide-spread use of PSC enhanced solar power will significantly reduce the carbon emission responsible for the global warming, therefore the PSC solar panels will become a key factor in saving the planet Earth.

Bio: Dr. Nish is a pioneer in the field of solar energy technology. He is actively involved in Molecular Dynamics simulations and Raman Spectroscopy research related to advanced material interfaces and nanomaterials for solar applications. His research related to advanced materials and solar applications motivated him to create SunDensity's SmartScreen Technology, which has the potential to revolutionize the solar energy industry.

His current research interests are focused on the development of solar quantum interactions for the development of ultra-high efficiency solar cells. He served as the Principal Research Scientist and Director of the Hypermedia Lab at MIT and conducted seminal research in the area of molecular dynamics and Raman spectroscopy of nano-interfaces. He also served as the associate research professor of Engineering at University of Massachusetts, Boston. He is recipient of numerous awards as the educator and also as the innovator. He received the $1 Million award as the innovator of the year by the Luminate Challenge fund in Rochester NY. He recently is also awarded NSF Phase II funding for the development of scalable manufacturing of photonic smart coatings for the enhancement of PV panels.

Dr. Sonwalkar is inventor of the “Combined Molecular Dynamics and Molecular Spectroscopic approach for the Design and Development of Advanced Energy Material Interfaces,” for the enhancement and augmentation of desired material properties of the advanced nano-composites. He has published numerous papers in the area of MD Simulations, Molecular Tribology, Ice-solid interfaces, Hydrocarbon-silicon interface, laser Raman Spectroscopy in the leading scientific and engineering journals. He has also presented papers in ASME, MRS, AGU and Gordon Conferences. For his scientific accomplishment he was awarded membership of the prestigious Sigma Xi, honor society. He has served as Principal Investigator on NSF grants and served on the review panel of NSF funding in the area of nanotechnology, tribology and surface science.