Title: Appendix H: Development of Nanotechnology-Enabled Sensors for Characterizing and Quantifying Particulate Matter in the Martian Atmosphere

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ABSTRACT: This talk will present the current status and possible future developments in the area of Nanotechnology-Enabled Sensors for Characterizing and Quantifying Particulate Matter in the Martian/Venusian Atmosphere. Exploration of planets, dwarf planets, moons, asteroids, and comets are dependent on well-designed and robustly engineered sensors to characterize the environmental conditions found in these extreme environments. NASA successfully operated the rotary-winged unmanned aircraft system (UAS) Ingenuity on Mars in 2021, demonstrating a transformational means for sampling atmospheric and surface conditions on this planet. Measurement of particles suspended in an atmosphere or released from the surface under the action of wind shear using a UAS demands an equally transformative advance in technology. The proposed work creates a path to a sensing technology for exploration offering improved long-term sustainability of detection performance in terms of durability, sensitivity, response time, and repeatability across a broad spectrum of environmental variables. The focus on Martian/Venusian atmosphere is due to its importance in multiple NASA initiatives that recognize dust plays a major role in the Martian/Venusian climate systems. We recognize, however, that this sensor technology could be used on other platforms (e.g., rovers, and aerostats) for exploration of other bodies in our solar system (e.g., Titan). The development of sensors to measure dust on Mars/Venus, which take into consideration Venus' middle atmosphere conditions and its unique extreme environment especially with vertical resolution capability, would support multiple high priority science investigations as described in the four key sections of Mars/Venus Science Goals, Objectives, Investigation, and Priorities. After a brief introduction of the general IoT sensors, nanomaterials for sensor applications are discussed. The technical challenges of sensors are discussed. This talk will introduce various technologies that are based on nanotechnology and will be discussed possible Nanotechnology-Enabled Sensors for Characterizing and Quantifying Particulate Matter in the Martian/Venusian Atmosphere.

Biography: Dr. Park is an associate professor in the Department of Electrical and Biomedical Engineering at the University of Nevada, Reno since July 2019. His expertise is in the areas of IoT sensors and sensor networks for advanced manufacturing, nanotechnology-enabled flexible hybrid electronics, nanoelectronics, semiconductor, and nanomaterials. Prior to that, he was an associate professor at the School of Electrical Engineering and Computer Science and the University of Ottawa from 2016 to 2019, and a scientist at SLAC National Accelerator Laboratory, Stanford University from 2014 to 2016. For six years, he served as a senior technologist to support the corporate chief technology officer (CTO) and business units at Applied Materials, USA. He has been a guest researcher at the Lawrence Berkeley National Laboratories, a visiting scholar in the Department of Electrical Engineering at Stanford University, and an adjunct professor in the Department of Electrical Engineering at Santa Clara University. He received his Ph.D. (2008) in materials science and engineering from the University of California, San Diego, USA. He is a senior member of IEEE.