Active Solid State Dosimetry for Lunar EVA. J.D. Wrbanek,[1] G.F. Fralick,[1] S.Y. Wrbanek[1] and L.Y. Chen[2] [1]NASA Glenn Research Center, Instrumentation & Controls Division, Cleveland, Ohio. [2]Ohio Aerospace Institute, Brook Park, Ohio.

Introduction: The primary threat to astronauts from space radiation is high-energy charged particles, such as electrons, protons, alpha and heavier particles, originating from galactic cosmic radiation (GCR), solar particle events (SPEs) and trapped radiation belts in Earth orbit. There is also the added threat of secondary neutrons generated as the space radiation interacts with atmosphere, soil and structural materials.[1]

For Lunar exploration missions, the habitats and transfer vehicles are expected to provide shielding from standard background radiation. Unfortunately, the Lunar Extravehicular Activity (EVA) suit is not expected to afford such shielding. Astronauts need to be aware of potentially hazardous conditions in their immediate area on EVA before a health and hardware risk arises. These conditions would include fluctuations of the local radiation field due to changes in the space radiation field and unknown variations in the local surface composition. Should undue exposure occur, knowledge of the dynamic intensity conditions during the exposure will allow more precise diagnostic assessment of the potential health risk to the exposed individual.[2]

Technology Need: An active personal dosimeter for Low Earth Orbit (LEO) EVA use is specifically recommended by NASA JSC's Radiation Dosimetry Working Group, and the National Council on Radiation Protection and Measurements (NCRP) recommends personal radiation monitoring for real-time dose rate and integrated dose in LEO.[3] Compared to the current LEO missions, the expeditions to the Moon will place crews at a significantly increased risk of hazardous radiation exposure.

Current radiation measurement and warning systems may be not adequate for the future Lunar missions, and currently instruments do not exist that can make these measurements and be incorporated into the Lunar EVA suit. However, MEMS devices fabricated from silicon carbide (SiC) to conduct low-noise neutron and alpha particle spectrometry have recently been reported outside of the context of personal dosimetry.[4]

Development Effort: NASA GRC has been leading the world in the development of SiC semiconductor technology, producing SiC semiconductor surfaces of much higher quality than commercially available, as shown in figure 1. These surfaces have demonstrated advantages over standard materials for other sensor applications.[5] In other activities, NASA GRC is attempting to verify claims of nuclear energy in sonoluminescence using thin film coated scintillation detectors fabricated at NASA GRC as part of the Vehicle Systems Program, shown in figure 2.[6]

NASA GRC is leveraging these efforts to investigate small and large area MEMS devices for sensitivity to radiation and to compare with commercial devices. If these initial results look promising as a path for the design and fabrication of a prototype solid state dosimeter, further testing would be required in conjunction with other researchers in the space radiation field over the next few years. The long term objective of this effort is to provide a compact, low power active electronic dosimetry system that would not be adversely affected by radiation, with improved sensitivity and detection capability for real-time monitoring of Lunar EVA conditions.

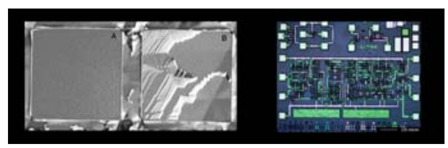

Figure 1: Examples of NASA GRC SiC Fabrication: Defect free (far left) & typical (center left) SiC surfaces, and a SiC circuit (right).

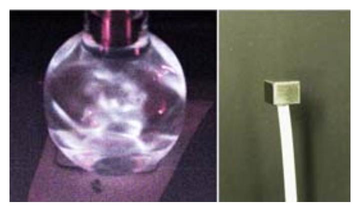

Figure 2: Radiation Detector Development: NASA GRC is attempting to verify claims of nuclear energy in sonoluminescence (left) using thin film coated scintillation detectors fabricated at NASA GRC (right).

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