Ultraviolet Testing of Space Suit Materials for Mars

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Human missions to Mars may require radical changes in the approach to extra-vehicular (EVA) suit design. A major challenge is the balance of building a suit robust enough to complete multiple EVAs under intense ultraviolet (UV) light exposure without losing mechanical strength or compromising the suit's mobility. To study how the materials degrade on Mars in-situ, the Jet Propulsion Laboratory (JPL) invited the Advanced Space Suit team at NASA's Johnson Space Center (JSC) to place space suit materials on the Scanning Habitable Environments with Raman & Luminescence for Organics and Chemicals (SHERLOC) instrument's calibration target of the Mars 2020 rover. In order to select materials for the rover and understand the effects from Mars equivalent UV exposure, JSC conducted ground testing on both current and new space suit materials when exposed to 2500 hours of Mars mission equivalent UV.

To complete this testing, JSC partnered with NASA's Marshall Space Flight Center to utilize their UV vacuum chambers. Materials tested were Orthofabric, polycarbonate, Teflon, Dacron, Vectran, spectra, bladder, nGimat coated Teflon, and nGimat coated Orthofabric. All samples were measured for mass, tensile strength, and chemical composition before and after radiation. Mass loss was insignificant (less than 0.5%) among the materials. Most materials loss tensile strength after radiation and became more brittle with a loss of elongation. Changes in chemical composition were seen in all radiated materials through Spectral Analysis.

Results from this testing helped select the materials that will fly on the Mars 2020 rover. In addition, JSC can use this data to create a correlation to the chemical changes after radiation—which is what the rover will send back while on Mars—to the mechanical changes, such as tensile strength.