Charge Decay Properties of Martian Regolith Simulant Particles

The Electromagnetic Physics Laboratory at the Kennedy Space has focused recently on testing and understanding the electrostatic properties of the JSC Mars-1 Martian Regolith Simulant for future robotic missions to Mars. In a dry environment such as that of Mars, electrostatic discharge can become potentially hazardous and therefore characterization of this phenomenon is crucial for mission success.

To characterize this phenomenon, experiments were designed to measure the charge decay characteristics of the simulant. Measurements were performed in a simulated Martian environment under both moist (12% relative humidity) and dry conditions (less than 1% relative humidity). For the experiments under dry conditions, the soil was baked out to remove excess moisture and was evacuated to pressures below 1 torr before each experiment was performed. Figure 1 shows the time it takes dry simulant to discharge once exposed to a high voltage corona under normal simulated Martian conditions at different temperatures. At lower temperatures the soil decays more slowly indicating the higher resistivity of the simulant.

This behavior is understood in terms of the current-voltage characteristics of the material. Tests of the I-V relationships (Figure 2) show that the soil possesses non-ohmic behavior when the soil is moist and ohmic behavior when the soil is dry. Using these forms of the I-V curves, theoretical relationships of the charge decay curves can be derived and match well with the experimental data in Figure 3.

Analyses of the moist and dry simulant indicates that the most important mechanism behind the charge decay of the Martian regolith is the moisture content of the soil. Possible use of this mechanism in the search for water on Mars is being investigated.

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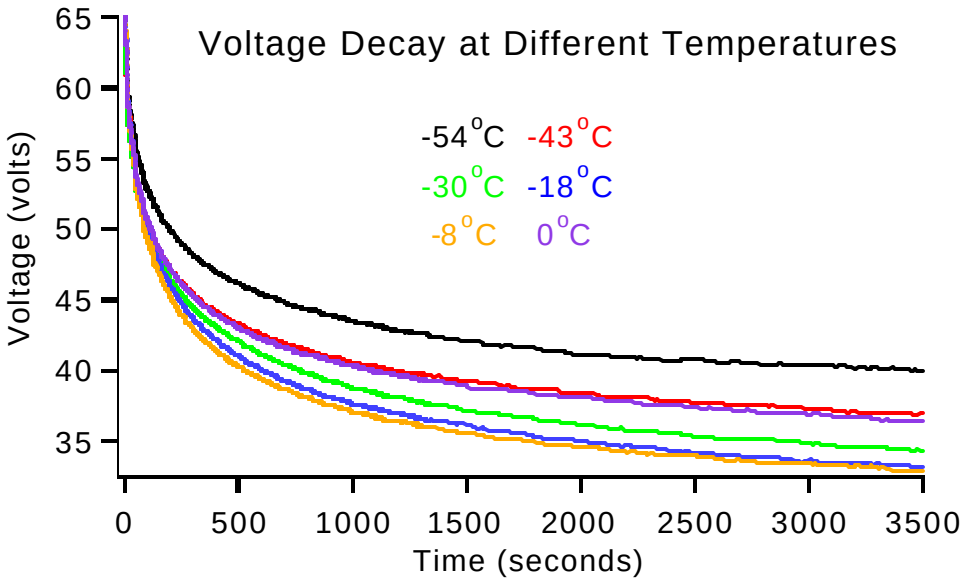

Figure 1. Average of many voltage decay curves at low temperatures under simulated Martian conditions.

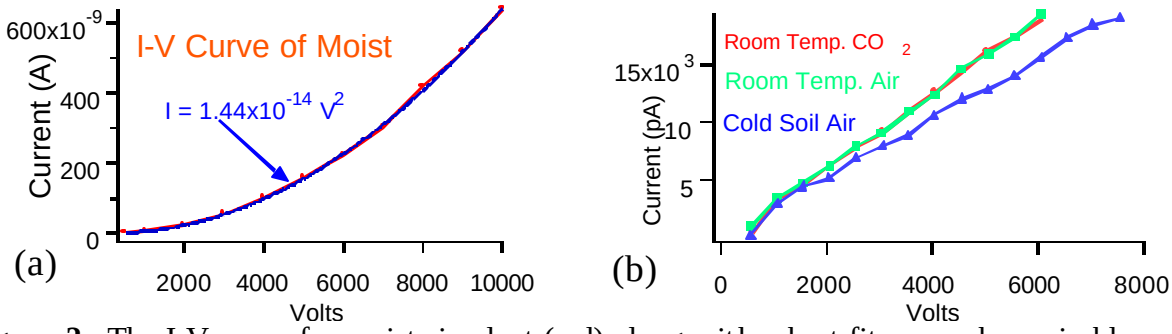

Figure 2. The I-V curve for moist simulant (red) along with a best fit curve shown in blue. (b) I-V curves of dry simulant.

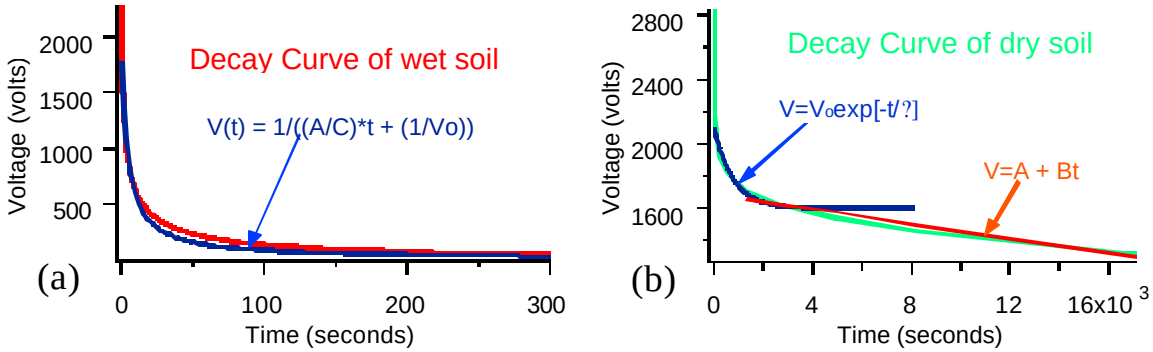

Figure 3. Decay curves for both (a) wet (red) and (b) dry (green) simulant along with best fit curves. The colors match the curves with their equations.