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Experimental and Theoretical Solar Cell Degradation Under Monte-Carlo Modeled Dust Deposition[1] PATRICIO PIEDRA, Desert Research Institute, NIC BERES TEAM, DR. HANS MOOSMULLER COLLABORATION, DR. PATRICK ARNOTT COLLABORATION, DR. VICKED ETYEMEZIAN COLLABORATION — Solar energy is very quickly becoming a crucial replacement of oil-derived energy. However, the efficiency of photovoltaic energy conversion gets reduced when dust becomes deposited on the solar panel. A large body of field experiments report energy conversion losses ranging from 1% to 65% depending on the location, tilt angle of the solar panel and mineralogical composition of the dust. Nonetheless, field experiments are ad hoc, and thus it remains challenging to derive universal patterns to predict photovoltaic efficiency of solar cells. In this study, we attempt to identify the key optical parameters that govern photovoltaic losses. A theoretical calculation of light transmission has been done for the particle-substrate system using the numerical scattering technique known as discrete dipole approximation (DDA). The DDA-substrate calculation has been validated using both Mie theory for free space and the T-matrix method for the sphere-substrate system. The coherence between the theoretical calculations is nearly perfect. In future study, we expect to validate these theoretical calculations using glass-dust light scattering measurements taken by an integrating sphere spectroradiometer. If the experimental validation of this calculation is successful, it will allow us to predict solar cell efficiency. This optical study can then be used to decide on materials for the solar panel, and to predict solar efficiency losses on locations that are not easily accessible such as space or deserts.

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