

Electrodynamic Screen Design for Removing Desert Dust from Solar Panels

J. Stark, R. Sumner, M. Mucci, P. Girouard, M. N. Horenstein, and M. K. Mazumder
Department of Electrical and Computer Engineering
Boston University
e-mail: mazumder@bu.edu

Abstract— Dust accumulation on solar panel arrays, particularly in desert areas, causes a significant loss of energy yield, which may vary from 10 to 30% depending upon the location. Periodic manual cleaning by water is both expensive and interruptive in power plant operation. Our previous studies on the applications of Electrodynamic Screens (EDS) show that automatic dust cleaning is possible without requiring manual labor and water. The EDS was constructed by depositing rows of conducting parallel electrodes on a dielectric substrate followed by the application of a thin transparent dielectric film coating to embed the electrodes. For convenience in depositing electrodes for three-phase operation we used printed circuit boards (PCB) as the dielectric substrate. When three-phase voltage pulses activate these electrodes, the dust particles on the surface of the film become electrostatically charged and are removed by the traveling wave generated by applied electric field. Most solar panels use borosilicate glass as cover plates for protecting the solar cells from environmental degradations. We report here our current studies on the integration of EDS on borosilicate glass substrate for three-phase operation. Methods of depositing electrodes, the application of dielectric film coatings, and the interconnection of the electrodes with the power supply are described along with the performance of the transparent EDS for removing desert dust. To accomplish the EDS integration on the glass plate, a set of three phase parallel electrodes was incorporated by photolithography followed by coating the substrate with a thin Polyurethane (PU) film to allow the application of pulsed phased voltage. The effectiveness of dust removal by the EDS was measured in a controlled environmental test chamber where the ambient conditions of the desert with respect to temperatures, relative humidity, and dust deposition can be simulated. Electrostatic charging of the dust particles and the efficiency of the removal process are reported along with a brief discussion on the long-term effectiveness of the EDS in desert atmosphere.