Development of Self-Cleaning Solar Mirrors Utilizing Transparent Electrodynamic Screens

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Abstract*— Dust deposition on heliostat and parabolic trough mirrors used in Concentrated Solar Power (CSP) systems cause 15 to 30% energy yield loss annually. Manual or robotic-arm assisted water based cleaning of these solar collectors used in MW or larger scale photo-thermeal and photovoltaic solar plants installed in semi-arid and desert areas is expensive and interruptive; water is scarce in those areas. The objective of our research program is to maintain solar collectors free from dust by employing transparent electrodynamic screens (EDS) for removing dust without manual labor or water. We report here the development of prototype transparent EDS-integrated mirrors using photolithographic deposition of chrome electrodes on borosilicate glass. Photolithography was used for fabricating lab-scale electrodynamic screens (EDS) for testing its performance first integrating it with solar panels and then with solar mirrors. The process involves using a laser mask writer to create the desired electrode design directly on a photo-plate, consisting of a glass substrate coated with a thin transparent conducting oxide (TCO) film with an overcoat of a photoresist film. A spiral design of the EDS electrodes for three-phase drive was created using CAD software, loaded onto a mask writer, for subsequent developing the photoresist film and to etch the film on the glass plate. We used chrome film for convenience in the etching process; the film can be replaced by a TCO. The test results of the prototype devices show that activating EDS can restore more than 90% of the energy yield or the reflectivity of the mirror within two minutes. The performance of the EDS integrated solar panels and solar mirrors in removing dust layers from the solar collectors will be reported along with the power requirements for EDS operation. The work was supported by the U.S. Department of Energy, SunShot Initiative! ; under the award number DOE CSP EE0005794.