

SOLAR PANEL CLEANING SYSTEM BASED ON A LINEAR PIEZOELECTRIC ACTUATOR

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Abstract

A linear piezoelectric actuator-based solar panel cleaning system is proposed to ensure that a solar panel operates at the best state of generation while using the solar panel in a dusty environment. To drive a wiper mounted on the actuator, a piezoelectric actuator linearly moving on a guide is used. The actuator can push the wiper at a correct pressure force between the wiper and the solar panel to efficiently wipe a dust layer away from the surface of the solar panel. The energy gain of the cleaning system, which is defined as the ratio of the electrical output increase of a solar panel caused by the piezoelectric actuator cleaning to the energy consumption, is much higher than 1. The merits of using the piezoelectric actuator in a solar panel cleaning system is that the cleaning system has light weight and compact structure, which is a common feature of piezoelectric.

Keywords— solar panel, piezoelectric actuator, wiper.

1. Introduction

Photovoltaic technology has advanced rapidly in recent years to generate electricity from sunlight. Solar panel cleaning techniques are investigated to maintain solar panels efficient[1]. There are mainly three cleaning methods, i.e., mechanical cleaning, nano-film based self-cleaning and electrostatic cleaning[2]. Mechanical technique has a big dust removal force, fast operation, excellent environmental adaptability and quality control compared to other techniques. However, due to its driving parts, the mechanical cleaning system generally has a large and heavy structure. Piezoelectric actuators have been successfully used in optical adjustment[3], biomedical manipulation, space exploration' ultra-precision measurement, and other areas, due to their merits such

as silent operation, no electromagnetic interference, high torque to volume ratio (5~10 times higher than electromagnetic actuators), flexible structure design, high positioning position, etc[4]. These merits make this sort of actuator competitive than standard electromagnetic actuators in many unique apps[1].



2. Experiment

Where ΔP is the increase of electric output power of the solar panel, P_{in} is the input electrical power of the prototype actuator[5], N is the cleaning times per unit time (/h), and Δt is the actuator's operating time for each cleaning. In the following experiments, flour is evenly distributed on the working surface of the solar panel to simulate the dust and is 256 g / m² in surface density[6]. The solar panel uses fluorescent lamps to generate 8420 lux light (measured by TES-1339R light meter). Different resistance values of the external resistor are used to get the maximum output power from the solar panel. For the clean panel, the optimum load resistance is 200 and 550 for the flour panel[7].

Result and conclusion

A solar panel cleaning system based on a linear piezoelectric actuator is intended,

manufactured and distinguished. Two elliptical movements of the driving legs are used in the linear piezoelectric actuator to drive the vibrator and the wiper. The prototype actuator operates well in both forward and backward operation, exciting by the 100 V_{0-p} driving voltage at resonance.

Reference

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