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Transparent Conveyor of Dielectric Liquids or Particles

A high-voltage electrodynamic screen would be implemented using transparent electrodes.

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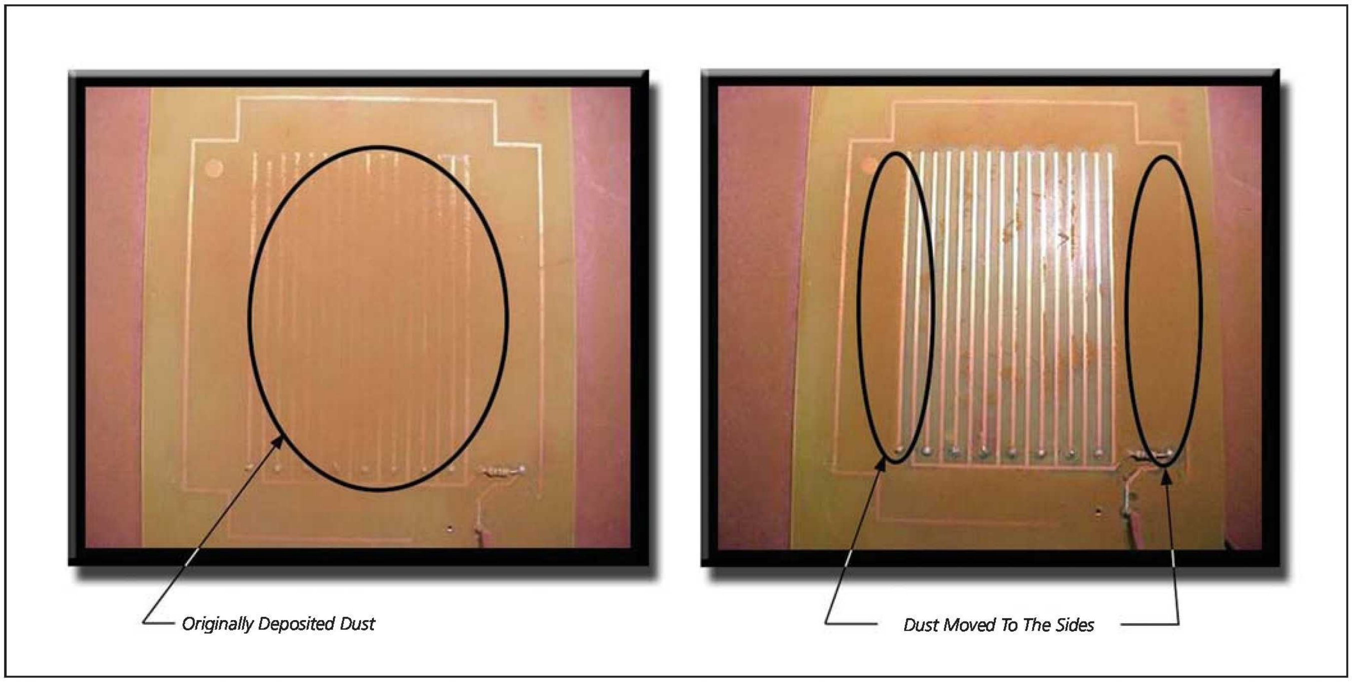
The concept of a transparent conveyor of small loose dielectric particles or small amounts of dielectric liquids has emerged as an outgrowth of an effort to develop efficient, reliable means of automated removal of dust from solar cells and from windows of optical instruments. This concept is based on the previously reported concept of an electrodynamic screen, according to which a grid-like electric field is established on and near a surface and is moved along the surface perpendicularly to the grid lines. The resulting electrodynamic forces on loose dielectric particles or dielectric liquid drops in the vicinity would move the particles or drops along the surface. In the original dust-removal application, dust particles would thus be swept out of the affected window area (see figure). Other potential applications may occur in nanotechnology — for example, involving mixing of two or more fluids and/or nanoscale particles under optical illumination and/or optical observation.

Heretofore, to implement an electrodynamic screen, one would bury a grid of parallel wires in the material below the affected surface and apply suitably phased voltages to adjacent grid wires to generate the desired electric-field pattern. Because wires are opaque, this approach is not satisfactory for any application in which transparency across a defined window area is required. The present concept of a transparent conveyor is based on the same concept as that of the buried-wire implementation of an electrodynamic screen, but with a significant difference: Instead of wires, one would use electrodes made of thin layers of indium tin oxide, which are both electrically conductive and transparent.

The fabrication of such a grid of electrodes would begin with the deposition (by sputtering or thermal evaporation) of a thin, continuous layer of indium tin oxide onto a substrate along which it was desired to transport particles or liquid drops. Standard photolithographic techniques would be used to remove portions of the indium tin oxide such that the remaining portions would constitute the desired array of parallel electrodes. The electrodes would be connected to a suitable single- or multi-phase voltage source. The exposed substrate and electrode surfaces would be coated with a layer of silicon dioxide or other transparent, electrically insulating material.

In operation in the single-phase mode, the indium tin oxide electrodes would be excited in the pattern (...AGAGA...), where A represents an applied alternating high voltage signal of amplitude *V* and G represents electrical ground. In a three-phase mode, the electrodes would be excited in the pattern (...ABCABC...), where A, B, and C represent the three phases of an alternating voltage of amplitude *V*. The frequency of alternation would determine the speed at which material would be transported. It would be necessary set *V* to exceed a minimum value required to initiate the transport process.

This work was done by Carlos I. Calle of Kennedy Space Center and James G. Mantovani of Florida Institute of Technology. Further information is contained in a TSP (see page 1). KSC-12616



A **Plate Containing Embedded Electrodes** was used to demonstrate the concept of an electrodynamic screen for removing dust. Dust was initially deposited in the middle of the plate, as shown at the left. After activation of the electrodynamic screen, the dust was found to have moved to the right and left sides.