or be electrostatically “clean.” These arrays must have their voltage separated from the space plasma and the array must be maintained at the same potential as the spacecraft. This is usually accomplished by coating the cell cover glass and arrays between the cells with a conductor. Since the coating for the cover glass must be transparent, a transparent conducting oxide (TCO) such as indium tin oxide is used. The coatings between the cells must not short them out, so an insulating coating must first be applied to all of the interconnects before the conductive coating or “v” clips. All of this must be done within a thickness of ~0.08 mm and within a width of about 0.8 mm.

Fabricating an electrostatically clean array presently costs three to six times as much as a typical array. This is due in large part to the hand labor involved in developing such arrays. These arrays are also less reliable due to the lack of robustness of the conductive coatings used to maintain the equipotential. In addition, these arrays are also generally body-mounted, which cuts down on the available power to the spacecraft (i.e. pointing issues, etc.). The power is also limited due to the thicker cover glass that is employed owing to the high-radiation environment associated with SEC missions. Unfortunately, there is not a wide knowledge base on how to develop electrostatically clean arrays. This was demonstrated in the cost of developing the Fast Auroral Snapshot (FAST) solar array. The electrostatically clean body-mounted solar panels for FAST cost in excess of $7400 per test condition watt.

The use of monolithic diodes on the latest generation of MJ solar cells could prove to be a tremendous advantage in developing electrostatically clean arrays. The presence of antennas, booms and outcroppings from a body-mounted array, requires that solar cells have bypass diodes to reduce the shadowing losses and potential damage to the arrays. The new built-in diodes will obviate the need and the expense involved in adding the diodes to the array circuitry. The NASA Goddard Space Flight Center (NASA-GSFC) recently funded Composited Optics Incorporated (COI) to study electrostatically clean arrays through the Solar Terrestrial Probe (STP) Program’s Magnetospheric Multiscale (MMS) and Geospace Electrodynamic Connection (GEC) projects. COI will be supplying the electrostatically clean solar panels for the Communication/Navigation Outage Forecast System (CNOFS).

10.5.8 Mars Solar Arrays

Mars orbiters have used PV arrays that are quite similar to those used in Earth orbit with good results. However, Mars surface missions, in which the solar spectrum is depleted at short wavelengths, causes the efficiency of the cells to be lower than that if the cells were operated above the atmosphere of Mars. The cell efficiency is reduced by about 8% (relative %). In addition, the effect of dust accumulating on arrays was observed on the Mars Pathfinder mission by monitoring the J_{SC} of cells exposed to the environment whose short-circuit current could be monitored on a routine basis. One cell indicated an increase in obscuration of about 0.3%/sol for the first 20 sols (note that a “sol” is a Martian day of 24.6 h). The other cell indicated that over a longer period of ~80 sols, the obscuration flattened out and seemed to be approaching an asymptote of around 20% obscuration [53]. Cells that are “tuned” to the Martian solar spectrum and methods for mitigating dust obscuration will be necessary to produce efficient arrays for Mars surface power.