A novel approach for connecting solar cells based on Si wire arrays.

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Recently, solar cells based on Si micro/nanowire arrays have emerged[1] as an alternative to their wafer-type counterparts, because they potentially combine the advantages of crystalline Si (c-Si), such as good efficiency, long lifetime, low toxicity, abundance etc., with those of cheaper thin film technologies (less material use, lower processing temperatures, etc.). Efficiencies of ~ 8% have been reported for such cells based on Si wire arrays grown by the VLS process (ref. 1-c) and it has been predicted that those cells could reach efficiencies larger than 17% using only a few percent of the Si volume of the wafer-type cells (ref. 1-d). Another approach for solar cells based on Si wire arrays makes use of VLS crystalline Si cores on which a-Si:H shells are deposited[2]; those cells incorporate an heterojunction between c-Si and a-Si:H and they usually deliver a higher open circuit voltage (V_{OC}) than their all-c-Si counterparts. Efficiencies of ~9% have been reached with those cells. A common feature of all those wire-based cells, is the use of a transparent conducting oxide (TCO) film for one of the contacts. The most popular TCO is indium-tin oxide (ITO), which is an expensive material due to the scarcity of In. It is recognized that suppressing the transparent coating (ITO or some other transparent oxide mixture[3]) would be a great step towards cost reduction of thin-film-type solar cells[4].

In this presentation, we propose a connection system free from ITO or any other transparent conducting coating for the solar cell. The solar cell architecture comprises a first family of core-shell silicon wires with a p-i-n structure. Those p-i-n wires are first grown (at ~ 575 °C) and they are connected at their root to a network of "bus" electrodes (base contact). The other connection of the p-i-n Si wires (the emitter) is accomplished by randomly-oriented nickel silicide ($NiSi_x$) nanowires which during their growth (at ~ 400 °C or even below) connect themselves to the previously grown p-i-n core shell Si NWs. The roots of those $NiSi_x$ NWs are connected to a second network of bus electrodes which are interdigitated with the base contact electrodes. We have reached efficiencies of ~ 5%, without any optimization of the cell architecture. The cell structure will be shown and explained in details and its advantages discussed at length.

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