SnO_2 nanoparticles as catalyst precursors for plasma-assisted VLS growth with controlled surface density

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Radial-junction (RJ) solar cells based on silicon nanowires (SiNWs) are currently being investigated and improved by several research groups around the world.[1-3] Stable single RJ solar cells with efficiencies over 9% have already been demonstrated.[4] In addition, there is room for the improvement, by combining different materials in tandem RJ Si NW solar cell structures, e.g. hydrogenated amorphous silicon (a-Si:H) and microcrystalline silicon (µc-Si:H) (see **Fig. 1-a**).

The current process for the fabrication of RJ solar cells implies the use of a thin metal layer of evaporated tin (Sn) and its exposure to a hydrogen plasma to form Sn droplets. The density of metal droplets must be optimized to achieve sufficient light trapping with the optimal NW density being in the range of 10^8 cm^{-2}.

In order to control the nanowire density, we have started to investigate the use of commercially available tin dioxide (SnO_2) nanoparticles (NPs) separated from a nanopowder as colloidal dispersions and further deposited onto the substrate with a controlled density. Different particle size distributions have been achieved by centrifugation and dilution processes. SnO_2 NPs have been reduced to metallic Sn droplets by the hydrogen plasma treatment (see **Fig. 1-b**). Silicon nanowire growth was achieved by VLS process using reduced Sn as the catalyst. Further investigations exploring the plasma conditions in order to obtain microcrystalline silicon onto SiNWs core in a PECVD chamber with SiH_4/H_2 gas precursors are being studied. The µc-Si:H has been deposited on SiNW and studied by SEM observation (see **Fig. 1-c**) and HR-TEM (see **Fig. 1-d**) techniques. In addition, we explore and optimize the quality of the intrinsic µc-Si:H material deposited directly on SiNWs for the use in single junction µc-Si:H solar cells.[5]

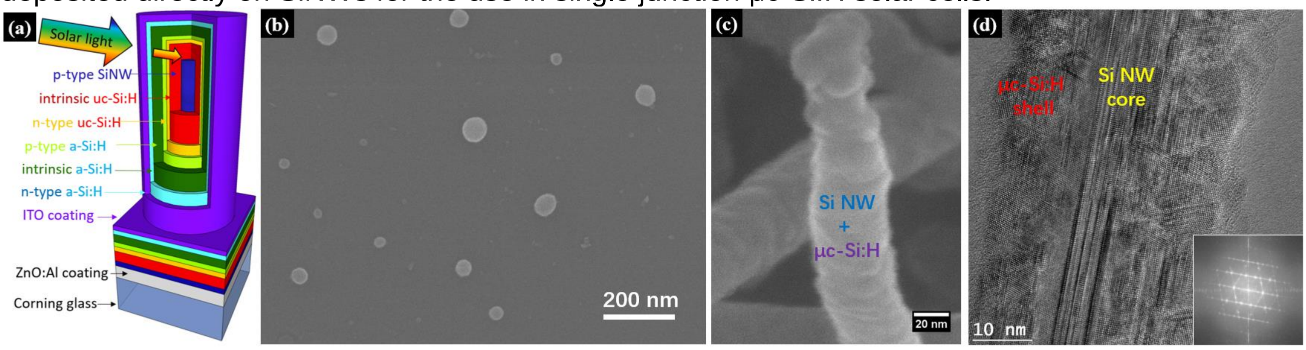

Figure 1. *(a) Illustrated schematic of tandem radial junction silicon nanowire solar cells; (b) Top view of SEM image of reduced Sn catalyst on silicon wafer; (c) SEM image of Si NW after µc-Si:H deposition; (d) HR-TEM image of core-shell structure of SiNW grown in <211> direction after µc-Si:H deposition.*

Reference

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