Microscopic experiments with radial junction solar cells based on silicon nanowires

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Microscopic measurements of Si thin films and nanostructures can provide interesting insights for their applications, e.g., for an operation of corresponding solar cells. This was the case for amorphous and microcrystalline Si films, but also for structures of polycrystalline Si on glass.

We shall illustrate our research approach for the case of radial junction solar cells on silicon nanowires (SiNWs). Radial junctions on nanowires are an example of modern nanostructured solar cell designs with excellent light trapping and efficient photogenerated charge collection. A single pump-down process used to prepare a randomly grown matrix of SiNWs and conformal p-i-n radial junctions led to cells with efficiencies over 8% [1]. Considerable influence of irregularities in SiNWs lengths, orientations, shapes and mutual interaction on the photovoltaic action can be expected. Direct measurement of these effects requires microscopic measurements of photoresponse. This is possible using atomic force microscopy (AFM) with conductive cantilever which serves as a contact to individual radial junctions [2]. Resulting conductivity maps show substantial variation of the local electronic properties. The AFM tip cannot reach deeper into the SiNWs matrix and correlation with scanning electron microscopy of the identical nanowires is sought in order to identify the reason for conductivity variations. The results will be discussed in terms of random photodiode arrays connected in parallel with overall performance limited by weak diodes.

[1] S. Misra *et al.*, Sol. Energy Mat. Sol Cells. 118 (2013) 90–95.
[2] A. Fejfar *et al.*, Sol. Energy Mat. Sol. Cells. (2013) 228–234.