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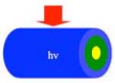
Effective light trapping in single coaxial nanowires

Hybrid, coaxial nanowire photovoltaic cells, consisting of a crystalline silicon (c-Si) core and an amorphous silicon (a-Si) shell are an appealing idea. In such c-Si/a-Si coaxial photovoltaic cells, the c-Si core can act as an efficient charge collector to compensate for short charge diffusion lengths of a-Si, whereas the a-Si shell can be used as an excellent energy absorber to overcome poor light absorption of c-Si. As a matter of fact, a few groups [*Nature* 449 885 (2007); *Nano Lett.* 10 4093 (2010)] have made such coaxial nanostructures and tested the great light absorption nature of the devices. However, the underlying physics of light absorption in the coaxial nanowire system requires further investigation.

Designing coaxial nanowires for photovoltaic applications

In a recent article published in *Nanotechnology* [22 125705 (2011)], researchers from Shanghai Jiao Tong University, China, and Boston College, US, have reported a thorough theoretical study of the light absorption in single c-Si/a-Si coaxial nanowires. The team has made great progress in establishing the fundamental mechanism of light absorption in c-Si/a-Si coaxial nanowires. In addition, the group found the geometrical optimum condition for coaxial nanowires, which provides efficient energy absorption while retaining excellent charge collection.

"We've obtained an increase in photocurrent of up to 560% in coaxial nanowires compared with silicon nanowires. It is beautiful that this happens when the a-Si shell thickness is equal to the c-Si core diameter." Mr W F Liu, the first author of the article, told *nanotechweb.org*.



Coaxial nanowire

Stepping-stone device

In addition, the group showed how to obtain a further increase in photocurrent (up to 60%) by coating nonabsorbing dielectric SiO_2 shells on the coaxial nanowires (see schematic view). "These super-hybrid c-Si (core)/a-Si (inner shell)/SiO_2 (outer shell) coaxial nanowires were considered in related work, and we believe they serve as a stepping stone to developing highly efficient integrated power sources to drive nanoelectronic devices." added Dr J I Oh, a co-author of the study.

Prof. Shen, who leads the team, revealed that the group is developing a prototype coaxial nanowire photovoltaic cell, which he hopes will complete the story of coaxial nanowires for photovoltaic applications.

About the author

The work was carried out at Shanghai Jiao Tong University, Shanghai, China, by Prof. W Z Shen and his research team, Mr W F Liu and Dr J I Oh. Dr W Z Shen is National Cheung Kong professor of condensed matter physics at Shanghai Jiao Tong University, China, and winner of National Science Fund for Distinguished Young Scholars. Prof. W Z Shen is leader of the Condensed Matter Spectroscopy & Optoelectronic Physics Laboratory and Key Laboratory of Artificial Structures and Quantum Control (Ministry of Education). Dr J I Oh is also affiliated with the Physics Department of Boston College, US, as a research associate professor. This work was supported by the National Major Basic Research Project of 2010CB933702 and the Natural Science Foundation of China under contracts 10734020 and 11074169.