

Nanotechnology Congress & Expo

August 11-13, 2015 Frankfurt, Germany

Growth and surface engineering of Si nanowires for opto-electronic applications

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Silicon Nanowires (Si NWs) are a promising candidate for the realization of highly integrated electronic, photonic and optoelectronic devices as well as for fundamental studies in natural sciences. As the dimensions are scaled down to nano-regime, the surface and interface area of the Si NW become more critical – to the level that they might control the whole semiconductor (opto) electronic properties. It is therefore essential to understand the surface properties and charge exchange between the NW surfaces and their bulk on a microscopic level. The lecture will be divided into three sections: (i) the growth of Si NW, (ii) engineering procedures and characterization of the surface properties, and (iii) the integration of the Si NWs into device prototypes. In particular for Si NWs, we will show bottom-up vapor-liquid solid growth as well as a top-down approach by reactive ion etching. Surface engineering is based on methods such as electro-grafting, laser-writing, and wet/dry chemical etching. The main analytical tool adopted in our research towards this goal is photoelectron spectroscopy. Band diagrams will be extracted from based on this analysis and correlated with electrical and material properties of the Si NWs. Along this route we have developed a new surface electron doping technique based on a combination of work function engineering and physisorption of appropriate dopant molecules. The perspectives of our results for Si NW based devices, specifically with respect to efficiency enhancement of hybrid organic-inorganic solar-cells and field effect transistor, will be discussed.

Biography

Muhammad Y Bashouti received his Bachelor degrees in Chemistry at the Hebrew University/Israel. He has completed his direct PhD in Physical Chemistry from the Technion-Israel Institute of Technology (IIT). He held a Postdoctoral position at the Max Planck Institute for the Science of Light at Erlangen (Germany) where he worked on optoelectronic materials with special emphasis on tailoring and characterization of their surface properties. He has published more than 28 papers in peer-reviewed publications, more than 770 citations and an h-index of 13. He serves as an Editorial Board Member of reputed journals.

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