

Keynote: The great promise of single-wall carbon nanotubes as an effective nanomaterial for photovoltaic applications

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The unique combination of highly attractive optoelectronic properties of single-wall Carbon nanotubes (SWCNTs) makes them the most appropriate nanomaterial for photovoltaic applications. Before discussing the effective integration of SWCNTs into PV devices, we will briefly recall some of our work on their synthesis by means of the KrF pulsed laser deposition technique and highlight their structural and optoelectronic properties relevant to PV applications. In order to form the p-n junction, the SWCNTs were appropriately purified, filtered and transferred as thin films onto n-silicon substrates. By varying the SWCNTs film density ($\mu\text{g}/\text{cm}^2$), we were able to point out the existence of an optimum value that yields the highest power conversion efficiency (PCE) of $\sim 11\%$. Further optimization of the doping of the p-SWCNTs along with the appropriate incorporation of an MoOx hole extraction layer into the p-SWCNTs/n-Si PV device structure, enabled us to reach a PCE value as high as 15%. With such a high PCE value, the SWCNTs definitely hold great promise for sunlight photoconversion. Indeed, the p-SWCNTs/n-Si PV devices have undergone an impressive increase of their PV performance over the last decade. On a more fundamental basis, we have been able to correlate a figure-of-merit (FOM) of the p-SWCNTs/n-Si PV device, calculated from the optical of the optical transmission and electrical conductance of the p-SWCNTs films, to their PCE performance. This direct relationship between the FOM and the PCE of these novel p-SWCNTs/n-Si devices is unprecedented and can be used as a guide for further enhancing their PCE.



My Ali El Khakani is a Full-Professor and the Leader of the “NanoMat” Group, he founded in 1998 at the Institut National de la Recherche Scientifique (INRS-Energie, Matériaux et Télécommunications, Varennes, Qc, Canada). He is an internationally recognized expert in the inter-related fields of laser/plasma based synthesis, modification, nanoassembly and characterizations of nanostructured materials (including nanotubes, nanoparticles and ultrathin films) and their applications for photo-electronic, photovoltaic and photocatalytic devices. He has published more than 220 refereed publications in prestigious journals, and he is a co-inventor in 5 patents. His research contributions are well cited with more than 450 citations/year over the last 5 years, and an overall H index of 36. The results of his R&D work have been presented in more than 250 national and international conferences. So far, more than 60 highly qualified personnel (at MSc, PhD and PDF levels) have been trained under his supervision. The R&D contributions and expertise of Prof. El Khakani are well recognized at both national and international levels, as testified by his numerous invited/keynote talks at international conferences, and through his appointments as a scientific reviewer for various public and private R&D funding agencies in different countries. He is also serving as a board member of steering committees of R&D Canadian organizations and/or Research networks. He is also serving as a member of the international scientific advisory boards of several international conferences. He

has also co-organized several scientific international workshops, symposiums and conferences. He has served on the editorial board of sensors letters, and he is currently member of the editorial board of the ISRN-Nanotechnology and Nature-Scientific Reports journals. He is also a regular reviewer for 25+ journals in his field of expertise. He has established productive scientific international collaborations with researchers in ten different countries.