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Single PANI and PPY nanowires for biomarker (Myoglobin) detection and highly selective chemicals sensor arrays

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Conventional nanowire synthesis such as solution-liquid-solid growth or laser ablation methods yield bundles of nanowires. Utilization of a nanowire from those methods requires many post-processes in order to build an electric device structure. In this talk, we report reproducible single and site-specific nanowire fabrication through an electrophoresis growth method. Single metallic or conducting polymer nanowires are electrodeposited inside a 100nm width nanochannel from electrolyte solution and aligned with electrodes on both ends of the nanochannel. This method greatly simplifies the process of building up an electric device with a single nanowire by eliminating troublesome steps such as nanowire positioning and alignment with electrodes. For sensing chemicals, single nanowires made from different materials, including palladium (Pd), polypyrrole (PPy) and polyaniline (PANI), were grown inside Poly(methyl methacrylate) (PMMA) channels between Au electrodes. With external electric fields from gate electrode under the nanochannels, single nanowires with diameters down to 30 nm and lengths up to 7 mm were synthesized on a single chip and utilized as chemical and biomedical sensors. Using these single nanowire arrays, we have sensed various gases such as H2, NO2, CH3OH, simultaneously, and analyzed electrical signals via principal component analysis (PCA). The feasibility of biomedical sensor applications based on both single PANI and PPy nanowire structures will also be demonstrated. IgG has been detected using functionalized single PANI nanowires. The fluorescent labeled antibodies were successfully stabilized on PANI thin film and sub-micro wire. A drop (~1μL) of PBS solution containing 50 μg/L (~2.5 nmol/L) IgG was sufficient to cause a significant drop in nanowire conductance. Finally, we will cover the fabrication of single PPY and PANI nanowires for the detection of myglobin, a well known biomarker for cardiovascular diseases. These successful functionalizations of PANI and PPy promise the new applications in multi-target biomedical sensing.

Dr. Minhee Yun is an assistant professor at the Department of Electrical and Computer Engineering of University of Pittsburgh. Before joining Pitt he was a Senior Technical Staff in the Device Application Group (2000-2005) at the Jet Proposal Laboratory (JPL). He has held appointments at University of Pittsburgh in the Swanson School of Engineering, Electrical and Computer Engineering, Bioengineering and Mechanical Engineering and Materials Science (MEMS) as an Assistant Professor. His current research interests include the development of nanostructure materials for bio-medication applications and he has over 50 publications. In addition, he is an executive board member of International Network for Engineering Education (iNEER). He received his B.S. from Chonbuk National University in the Korea in 1992, a MS and a Ph.D from the Arizona State University in 1996 and 1998, respectively.

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