Glucose biosensor based on gold nanoparticle-modified carbon nanotubes grown directly on Si

Yan-Shi Chen, Jin-Hua Huang*
Department of Materials Science and Engineering
National Tsing Hua University
Hsinchu 300, Taiwan
E-mail: jihhuang@mx.nthu.edu.tw

A simple and efficient method for making glucose biosensors via surface modification of carbon nanotubes is achieved. The sensor was prepared by e-beam deposition of gold nanopartices (NPs) on arrayed multi-walled carbon nanotubes (MWCNTs) grown directly on Si substrates by microwave-heated chemical vapor deposition. Glucose oxidase (GOx) was immobilized onto gold NPs, which were modified with a self-assembled monolayer of thioglycollic acid in advance, via covalent attachment by carbodiimide coupling reactions. Analysis using high resolution X-ray photoelectron spectroscopy and high-resolution transmission electron microscopy (HR-TEM) (Fig. 1) reveals that the as-deposited MWCNTs have crystalline gold metal coating. The amount of enzyme loading was estimated by HRXPS. Amperometric measurements were applied to characterize the sensor behavior. Significant enhancement in glucose sensitivity of the sensor has been achieved by controlling the amount of enzyme loading through gold coating. The Au-modified CNT electrode shows a linear response to glucose concentration with high sensitivity ranging from 15.16 to 75.75 μA mM^{-1} cm^{-2} (Fig. 2).

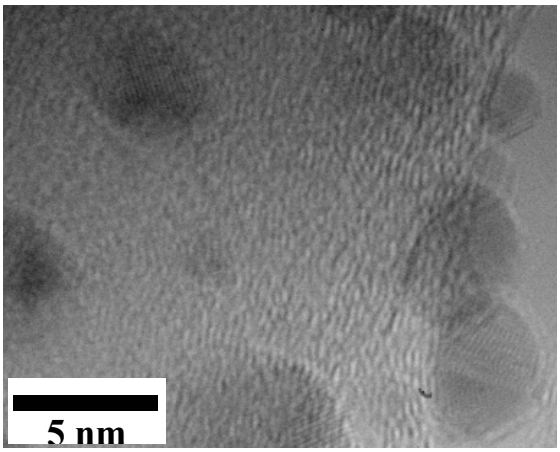

Fig. 1. HR-TEM images of Au nanoparticles on MWCNTs showing crystalline structure.

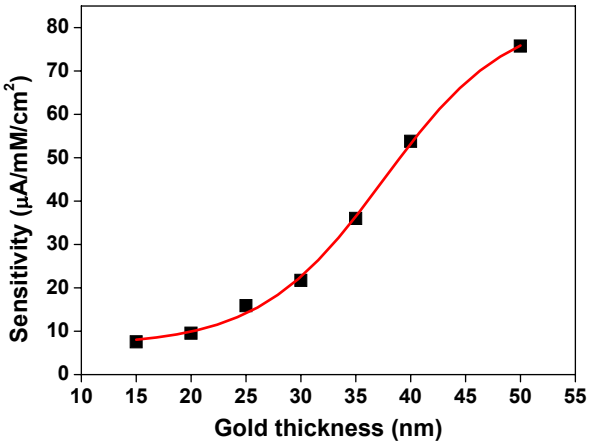

Fig. 2. Sensitivity as a function of deposited gold thickness relating to enzyme loading.