Operation of equipment by supporting staff

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Nanostructured metal oxides for biosensing

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Abstract During the period of support (Sept 2009 to March 2009), we got 35 samples analyzed using X-ray photoelectron spectroscopy. Different sample of metal oxides such as SnO2, TiO2 and ZnO in film and powder form were sent for analyses. A survey spectrum and detailed spectrum of elements like Sn, O, C, Zn, Ti, N were obtained. The results are being used as a support with other elemental analyses. Research papers using the obtained data is under write-up, which will be communicated with dully acknowledgement of the support obtained from Kyoto-Advanced Nanotechnology Network. The obtained data are as per the expectation and are consistent with the reported binding energy values of the studied elements.

Background

X-ray photoelectron spectroscopy (XPS) is a quantitative spectroscopic technique that measures the elemental composition, empirical formula, chemical state and electronic state of the elements that exist within a material. In case of biosensing, this helps in obtaining the information about the amine bond (which can be observed from the presence of N1s peak). The main aim of this support was to get information about the chemical elements and possibility of forming covalent bond with biomolecules of interest.

Objective

Interdisciplinary approach of materials science has open varieties of opportunities for researchers to explore mixed materials. We plan to explore metal oxides for biosensing applications.

Experiment

Samples, of SnO2, TiO2 and ZnO, to be studied by XPS were prepared in film and powder form. Films were deposited using PECVD and doctor blade techniques while nanosized powders were prepared using solution synthesis and hydrothermal synthesis. The XPS studies were carried out for the sample with and without immobilized biomolecules (like urease, glucose oxidase etc.). Total 35 samples were analyzed using XPS for survey and detailed spectra.

Results and Discussion

In order to confirm the immobilization on the SnO2, TiO2 and ZnO samples were characterized for surface bonded states using X-ray photoelectron spectroscopy. Figure below depicts the narrow scan spectra of the film before and after Glucose oxidase (GOx) immobilization for SnO2 prepared by hydrothermal method. It is clear from these spectrums that GOx has immobilized on SnO2 and resulted in a clear N 1s peak, indicating the formation of a covalent bond with the host material.

Similar studies were carried out for ZnO and TiO2 material. Research paper based on these observations is under preparation and will be communicated soon.
**Conclusion**
With the support of Kyoto-advanced nanotechnology network, we could get XPS observations of our samples (about 35 samples). The results obtained at consistent with the reported binding energy values of the chemical elements under investigation.

**Papers to be published**
[1] Urea sensing characteristics of Titanate nanotubes deposited by electrophoretic deposition  
[3] Effect of urea sensing on the electrical characteristics of hydrothermally deposited SnO$_2$  
[4] Effect of glucose and urea on the sensing properties of Pd-dopes SnO$_2$

**Keywords**
Biosensing, metal oxides, XPS, Nanostructure