NANO HIGHLIGHT
Nano-Composite Metal Oxides for Electronic Noses

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Synchrotron X-ray Characterization: One of the most important goals of the NIRT program is to develop new technologies for the characterization of nano-scale materials. As is well known, synchrotron sources are well collimated and have intensities that are tens of thousands times greater than laboratory sources. The brightness of these sources has opened up new fields of research and allowed for the investigation of very fine structures such as those at the nanoscale. Grazing Incidence XRD (GIXRD) is a particularly suitable technology for thin film characterization [1]. By increasing the path length of the incidence X-ray beam through the film, the intensity from the film can be increased so that conventional phase identification analysis can be carried out. In this project, we have combined the advantages of both synchrotron radiation and the grazing incidence geometry to investigate the structure of our metal oxide nanowires [2]. We have used the highly collimated synchrotron radiation beam at beamline X18A at the National Synchrotron Light Source at Brookhaven National Lab. The stationary incident beam makes a very small angle with the sample surface (typically 2^o to 5^o), which increases the path length of the X-rays. A dramatic increase in the film signal-to-noise ratio is achieved [3].

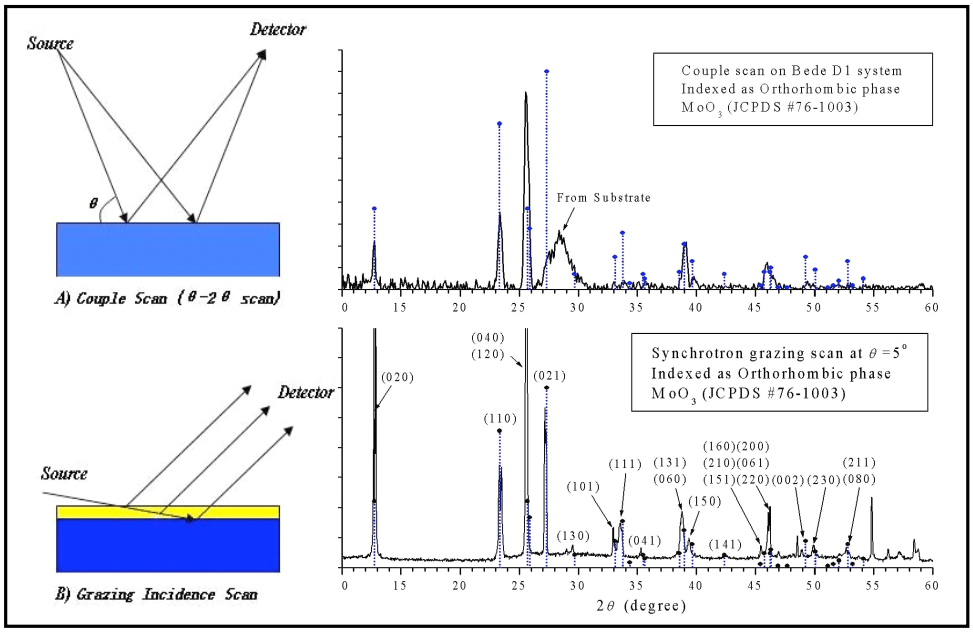

Fig1: A) Coupled scan geometry and the XRD from a coupled scan of MoO_3 nanowires using conventional laboratory X-ray source;
B) Grazing incidence XRD using the synchrotron radiation at BNL

Figure 1 compares the geometries and diffraction spectra of the commonly used coupled scan and the synchrotron grazing incidence scan. It is evident that the latter gives a much improved signal-noise ratio. Some weak peaks, which cannot be detected in (A), become apparent and are indexed in the GIXRD spectrum (Fig. 1(B)). Another exciting development is to apply synchrotron radiation to determine the surface texture of the nanowire films. This phenomenon is investigated by scanning the surface (_) of the sample while keeping the detector at a particular diffraction angle (2_). Future work will focus on the in-situ observation of phase transitions during thermal aging of the metal oxide nanowires.

References:

[1] A.L.Golovin, R.M.Imamov, and S.A.Stepanov. *Acta Cryst.A*, 40:225, 1984.
[2] A,K, Prasad, S. Gadia, and P.I. Gouma, Microsc. Microanal. 10, p. 314, 2004.

[3] M. Dudley et al, unpublished research, 2004.