



Ref. 322/23

Date: ২০ আশ্বিন ১৪৩০  
০৪ জুলাই ২০২৩

## CARS SEMINAR SERIES

**Speaker:** Dr. Sheikh A. Akbar  
Professor, Department of Materials Science and Engineering  
Founder, The National Science Foundation (NSF) Center for Industrial  
Sensors and Measurements (CISM)  
The Ohio State University (OSU), Columbus, OH, USA

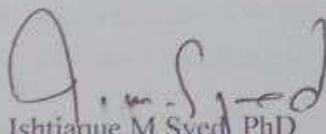
**Title:** Ceramic Nano-heterostructures by Materials Design: Platforms for  
Sensing and Biomedical Applications – Opportunities and  
Challenges

**Venue:** Training Room (1<sup>st</sup> Floor), Center for Advanced Research in Sciences  
(CARS), University of Dhaka

**Date:** Tuesday, 11 July 2023

**Time:** 11.00 am

You are cordially invited to attend the seminar.

  
Ishtiaque M Syed PhD 04 JUL 2023  
Professor of Physics &  
Director  
Centre for Advanced Research in Sciences (CARS)  
University of Dhaka.

**Prof. Dr. Ishtiaque M. Syed**  
Director  
Centre for Advanced Research in Sciences  
University of Dhaka, Dhaka-1000



## **Ceramic Nano-heterostructures by Materials Design: Platforms for Sensing and Biomedical Applications – Opportunities and Challenges**

Sheikh A. Akbar

*Department of Materials Science and Engineering  
The Ohio State University (OSU), Columbus, OH 43210, USA*

This talk summarizes R&D efforts in the author's laboratory on the fabrication of oxide nano-heterostructures, exploiting intrinsic material properties, that are highly scalable and do not require use of lithography. One such process creates crystallographically oriented nanofiber arrays of single crystal  $\text{TiO}_2$  in  $\text{H}_2/\text{N}_2$  environment.  $\text{H}_2/\text{N}_2$  heat treatment was also used to grow nanofibers on polycrystalline  $\text{SnO}_2$ , showing directional growth on grains with crystal facets. We have also developed a process to create nanofibers of  $\text{TiO}_2$  on Ti metal/alloys via oxidation under a limited supply of oxygen. In another process,  $\text{SnO}_2$  nanowires grown from commercial FTO slides using the vapor-liquid-solid (VLS) method were placed in a microwave-assisted hydrothermal chamber where  $\text{TiO}_2$  nanorods nucleated radially from the  $\text{SnO}_2$  nanowire cores. We developed yet another interesting nano-structure (nanoislands and/or nanobars) during thermal annealing of an oxide (GDC) on top of another oxide (YSZ) substrate that self-assembles along the softest elastic direction of the substrate. What is common about these structures is that they are fabricated without the use of lithographic techniques and involves simple processes such as gas-phase reactions and stress-driven processes. These nano-heterostructures can be used as platforms for chemical sensing, catalysis, photocatalysis, photovoltaics and biomedical applications. Sensing application presents opportunities and challenges that are presented including an Open access Database Of Resistive type gas Sensors (ODORS) that has been developed and can be used to select suitable sensing materials.



**Dr. Sheikh A. Akbar** is a Professor of Materials Science and Engineering at The Ohio State University (OSU) in Columbus, OH, USA. After studying for two years (1973-75) in the Physics Department of Dhaka University (Bangladesh), he completed his MS degree in solid state physics from University of Sofia (Bulgaria) in 1980 and PhD in Materials Engineering from Purdue University (USA) in 1985, followed by two years of post-doc and finally joining the faculty of OSU in 1987. His recent work deals with synthesis-microstructure-property relations of ceramic bulk, thin-film and nano-heterostructures. Dr. Akbar was the Chair of the 12<sup>th</sup> International Conference on Chemical Sensors (IMCS-12) held in 2008. This meeting was attended by 330 participants from more than 30 countries. He was also a major symposium organizer of IMCS-18 in 2021. Dr. Akbar's sensors received three (3) R&D 100 Awards as part of the 100 best inventions of 2007 and 2005 selected by R&D Magazine and 2005 NASA TGIR (turning goal into reality) award. Dr. Akbar is the recipient of the 2012 Electrochemical Society Sensor Division Outstanding Achievement Award, the 2002 Tan Chin Tuan Fellow of Nanyang Technological University in Singapore, and the 2001 Fulrath Award and the 2002 W.E. Cramer Award of the American Ceramic Society. He was elected a Fellow of the American Ceramic Society (ACerS) in 2001 and a Fellow of the Electrochemical Society (ECS) in 2018. He also received the 1993 B.F. Goodrich Collegiate Inventors Award for the development of a rugged and durable CO/H<sub>2</sub> sensor; *one of three national awards*. Dr. Akbar has served on the International Advisory Committee of CIMTEC conferences, Steering Committee of the International Conference on Engineering Education (ICEE), Technical Steering Committee of the US-DOE Sensor and Controls Program, and the Steering Committee of the US-Japan Conference on Sensor Systems for the 21<sup>st</sup> Century. He has co-organized sensor symposia for the American Ceramic Society, the Electrochemical Society, IMCS (USA, Korea, Austria, Canada), ICMAT (Singapore), AMEC-4 (China), ICC3 (Japan), CMCEE (Canada) and ICC8 (Korea). Dr. Akbar has co-edited 2 books on sensors. In 2003, he served as the Guest Editor for two special sections of the Journal of Materials Science, "Chemical Sensors for Pollution Monitoring and Control" and "Chemical and Bioceramics." He was the Principal Editor of special issues entitled, "Nano-structured Ceramic Oxides: Challenges and Opportunities" and "Energy and Environment: Role of Advanced Materials" published by the American Scientific Publisher in 2011 and 2014, respectively. He was also the Guest Editor of a special issue entitled, "Sensing at the Nano-scale: Chemical and Biosensing" published in 2012 in *Sensors* and "Nano-hetero-structures for Chemical Sensing: Opportunities and Challenges" published in *Frontiers in Materials* in 2019. He was a distinguished lecturer in 2017 SJTU International Summer School of Advanced Materials (ISS-AM) in Shanghai, China. Dr. Akbar was elected an Editor of *Sensors and Actuators B Chemical* in 2018, a role he is continuing. He has served on the Editorial Boards of the *Journal of Nanoengineering and Nanomanufacturing*, *Materials Focus*, *Sensors*, *Ceramics International*, *Journal of Nanomaterials*, *Sensor Letters* and *Frontiers in Materials* (Functional Ceramics Chief Editor). He has published more than 265 technical papers and holds 8 patents garnering over 12900 citations with an h-index of 53. Dr. Akbar received the Mars G. Fontana Outstanding Teacher Award in Materials Science and Engineering (OSU) for both 2016 and 2017. In 2023, he received the Alumni Distinguished Teaching Award, the highest distinction in teaching at OSU.

