Seminar

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Institute for Plasma Research

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Title: Development and characterization of CuO thin films and ZnO/CuO heterostructure by PVD process for CO gas sensing application

Speaker: Dr. Debashrita Mahana
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Date: 07th June 2024 (Friday)

Time: 02.00 PM

Venue: Online

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Abstract

Toxic air pollutants such as CO, NO2, NH3, H2S and others are hazardous to humans and other living organisms. The poisonous quality of CO gas, in particular is very concerning because it causes a variety of diseases. Due to their accessibility and superior sensing capabilities, metal oxide semiconductors have been discovered to be very helpful for detecting CO gas. CuO is one of the promising metal oxides for gas sensing applications because of its strong chemical and thermal stability, non-toxicity, low cost, catalytic activity and natural abundance. In this research work, gas sensors have been developed based on CuO thin films synthesized using physical vapor deposition processes.

CuO thin films are successfully synthesized by thermal oxidation of Cu films deposited by vacuum evaporation and sputtering processes at 400 °C for 2-5 h. The synthesized films have been characterized with x-ray diffraction, field-emission scanning electron microscopy, UV-Vis spectroscopy, x-ray photoelectron spectroscopy, etc. The thermal oxidation process of sputtered Cu films with finer grains is found to be slightly faster than the evaporated Cu films with coarse-grains. Upon exposure to CO gas of 915 ppm concentrations, the sputtered CuO film exhibited a maximum response of about 175% against the CO sensing response of 146% for the thermally evaporated film, at the operating temperature of 375 - 400 °C. CuO films synthesized by the thermal oxidation of 200 nm thick metal Cu films showed better-sensing characteristics towards low concentration CO gas of 106 ppm with a maximum sensitivity of 51 %. Further, ZnO/CuO heterostructure sensor exhibits about a 2-fold enhancement in sensing response compared to bare CuO films against CO gas. For CuO thin films synthesized by DC reactive sputtering, the gas sensor displays an excellent sensing response of 127% towards 91 ppm CO gas concentration at 375 °C. The experimental conditions, the critical change in surface morphology and CO characteristics of CuO and ZnO/CuO structures will be discussed in detail.