THESIS DEFENCE

Speaker: Ms. Mousumi Sinha
Roll No.: 11102073
Title: Gas Sensing Studies of Doped Polyaniline based Flexible Gas Sensors
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Abstract: Flexible gas sensors, with possible benefits in low manufacturing costs and form factors, are an emerging field in the area of flexible electronics. The use of conducting polymer based sensing elements on flexible substrates are investigated due to several advantages over conventional metal oxide based sensors because of its tunable electronic properties, sensing at room temperature and amenable processing. The sensitivity and selectivity of such sensors are important performance parameters and their low values limit their utilization in a wide range of applications. Therefore, it is necessary to investigate the mechanisms affecting sensitivity and selectivity of such sensors along with the optimization of different materials, geometries, and processes to make them versatile. In this work, first doped nanoscale polyaniline thin films were used for sensing different pollutant gases like NH3, NOx etc. and their detailed sensing mechanisms were studied through energy consideration to explain the sensing behaviour. Then, different doped polyaniline structures (fibers and clusters) were synthesized and also tested for gas sensing of the analytes followed by the understanding of transport, reaction and transduction mechanism involved. Detailed response correlations were developed utilizing the parameters extracted from transport (diffusivity), reaction (time constant of adsorption and desorption), transduction (temperature and concentration dependent transduction) mechanism along with physicochemical characteristics of the sensing material. Correlations were well-fitted for a range of analytes with different structures of doped polyaniline. In the follow-up work, kinetic evolution of the doped polyaniline structures was studied to enhance their gas sensing performance. In subsequent work, surface unctionalized substrates were used to fabricate self-assembled doped polyaniline based flexible gas sensors. Performance of the self-assembled sensors was observed to be improved in a higher range when compared with that of thin film based sensors. In addition, for the selective sensing of volatile organic compounds (VOC), the doped polyaniline structures were functionalized with different ligands and sensor arrays were developed.