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THIN FILM TECHNOLOGY IN THE FIELD OF ENVIRONMENT

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ABSTRACT

Environmental conservation is a challenge to the mankind. The measures to check it must be easy to use, cheap and eco friendly. Thin film technology is providing answers to some of these problems. Nanostructured thin films of metal oxide are used in solar cells, semi permeable membrane, protective coatings, electronic devices, optoelectronics etc. Recently thin films have been developed to be used in different fields of environment. These include gas sensors, nanofilters etc. A brief review of the work done in this field is given in this paper.

Keywords:
Nanotechnology, Thin Films, Environmental Science.

INTRODUCTION

Thin film technology has developed since a long. There has been a continuous refinement in the thin film preparation techniques as well as its applications. Nanostructured thin films, due to increased surface to volume ratio are more reactive. Metal oxide thin films have found to be useful in the field of environment. The commonly used thin film preparation techniques are Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), Sol-Gel method and Spray pyrolysis methods. The various optical, electrical and chemical properties of thin films changes on exposure to different environments. Thin films are characterized by SEM, TEM, two probe resistivity, positron annihilation lifetime spectroscopy, XRD, UV-visible spectrophotometer etc. Based on these characterizations thin films are used for specific purposes.

THIN FILMS IN THE FIELD OF ENVIRONMENT

Environmental degradation has posed many challenges before us. Natural resources are being harnessed enormously at one end and their stock is exhausted day by day. On the other hand we disturb the ecological balance and pollute the different natural resources. Man has to solve air water and soil etc. pollution problems and fight against land degradation, natural disasters as well as manmade disasters, world food problem and conservation of forest etc. Metal oxides such as tin oxide, copper oxide, cadmium oxide, iron oxide thin films have been prepared and characterized

Tin Oxide thin films' pH response was investigated by Hung-Kwei Liao[1] in 1998. SnO_2/SiO_2 gate ISFET was fabricated and they determined its pH sensitivity through a shift in the threshold voltage of an ISFET sensor. Their experimental data showed that the SnO_2/SiO_2 gate ISFET sensors have

a linear pH response of about 58mV pH^{-1} in a concentration range between pH 2 and pH 10. They also investigated other characteristics of the sensor like temperature effect, drift effect, hysteresis and response time etc.

Gas sensors are developed by using metal oxide thin films. The absorption of gases by thin films changes the resistivity of the film by altering the charge career concentration .Seiyama[2] et al. investigated this first in zinc oxide thin films. The target gas response depends on the environment of the thin film. Humidity effect has been studied by Korotcnkov[3] et al. The effect due to presence of other gases has been investigated by Wang[4] et al. Photo catalytic oxidation and photo induced hydrophilicity of several metal oxide thin films has been investigated by Masahiro Miyauchi[5] et al. in 2002 . They found that SnO_2, TiO_2 and ZnO thin films are active in both processes. The response of nanocrystalline CuO thin films to H_2S gas has been studied by Dattarya Jundale[6] et al. in 2011. They studied effect of temperature and gas concentration. They achieved maximum H_2S gas response of 25.2% at gas concentration of 100 ppm at operating temperature 200^0C.

Thin films can also be used in the investigation of soil contamination. Volatile Organic Compounds (VOC) present in the soil may pose health problems. Rincon M.[7] et al. (2010) devised a gas sensor array for contaminated soil analysis. The usual methods for soil analysis are based on high resolution gas chromatography. These techniques allow compounds identification by means of retention time and spectral differences. Metal oxide gas sensors change their resistivity when exposed to VOC. This device is low cost, small size and micro electronically compatible. Use of gas sensors array improves performance.

Water pollution is yet another environmental problem that we are facing. For water purification conventional methods such as Chlorination and UV treatment are used. Nano structured thin films with large surface to volume ratio are promising material in this field. Water purification by nanostructured Zinc oxide thin films has been investigated by Sunandan Baruah[8] et al. (2012). Heterogeneous photo catalytic systems via metal oxide semiconductors like TiO_2 and ZnO are capable of operating effectively for water purification. It is considered that multifunctional photo catalytic membranes using ZnO nanostructures are more useful for water purification i.e. removal of fine contaminations and destroying the toxic materials.

Andrew R. Lukas[9] et al. studied the diffusive gradients in thin films (DGT) technique for quantitative assessment of distribution of dissolved Au, As and Sb. Contamination of groundwater may be evaluated by groundwater grab sampling. The DGT technique has been found to be more effective. The DGT technique was modified for Au by evaluating a gel- less configuration, with diffusion onto an activated carbon binding layer being controlled by .13 mm thick filter membrane. Sun Q.[10] et al. developed a high capacity DGT technique for measurement of total dissolved inorganic As in waters and soils using a hydrous Zr-oxide binding layer. They showed that Zr-oxide DGT was a reliable and robust tool even for soil samples heavily polluted with As.

CONCLUSION

Nanostructured thin films of metal oxide are being studied and developed by various researchers for use in the field of environment. The metal oxide thin films are more reactive and can be

developed as a powerful tool to cover the different aspects of environmental problems. Thin film technology is cheap. It has a vast potential. Gerge F.Fine[11] et al. in their review paper summarized the development of gas sensors in the field of environmental monitoring. Some metals are toxic so the science community has to find a way out of it. More investigations for different metal oxide thin films can reveal useful information for us that can be helpful to fight against the environmental problems. DGT technique is useful for water as well as soil pollution. With the enhanced knowledge of metal oxide thin films more cost effective techniques may be developed in near future.

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