Introduction

Aluminum-doped cadmium oxide (CdO:Al) thin films are deposited on silica substrates by the sol–gel spin-coating method as a function of spin coater’s rpm (revolution per minute). Cadmium acetate dihydrate and Aluminum nitrate have been taken as the precursor material and a source of Al-dopant respectively. CdO:Al thin films are characterized by x-ray diffraction (XRD), Fourier Transform Infrared (FT/IR), Field emission scanning electron microscopy (FE-SEM) and SEM-EDX. XRD result indicates the highest crystallinity at 6000 rpm with a crystallite size of 31.845 nm, cubic phase formation, and strain of ~1.6 X 10^{-2}. FE-SEM/SEM/EDX shows the well-faceted homogeneous surface structure at 6000 rpm having the average particle size of 130.05 nm. FT/IR confirms the presence of CdO:Al in the film with the peak position shifting to higher wavenumbers.

Why CdO:Al Thin Films?

- Power applications (Optoelectronic devices), Biomedical applications (Low toxicity, Drug Delivery, Material Durability and Biosensors)

Why Sol-Gel Process

- Cost effective, Low temperature technique, Easy to fabricate thin film (oxide, nitrides and carbides), Uniformity, Thick or thin films and variables easy to change

Materials Used

- Cadmium Oxide (CH\textsubscript{3} COO)\textsubscript{2}Cd\textsuperscript{2+}\textsubscript{2}H\textsubscript{2}O, Aluminum Nitrate (Al(NO\textsubscript{3})\textsubscript{3}\textsuperscript{2+}\textsubscript{2}H\textsubscript{2}O, 91% Isopropyl alcohol, Acetic acid (CH\textsubscript{3} COOH) and Silica substrates

Thin Film Characterization Tools

- Fourier-Transform Infrared (FT/IR)
- Raman Scattering
- X-Ray Diffraction (XRD)
- Surface Roughness
- Field Emission Scanning Electron Microscopy (FE-SEM)
- SEM/Energy Dispersive Spectroscopy (SEM/EDX)

FT/IR Spectra of CdO:Al/Silica Thin Film

- Peak position of 400-550 cm\textsuperscript{-1} indicates CdO to be present in our samples
- Peak position shifts to high wave numbers with increasing rpm values

X-Ray Diffraction (XRD)

- This figure represents a \( \beta \) cos \( \theta / \lambda \) vs 4\( \theta \) plot for a CdO:Al thin film. The slope indicates the amount of strain, which equals ~1.06 X 10^{-2}. The intercept on the \( \beta \) cos \( \theta / \lambda \) axis gives the crystallites’ size as 31.845 nm.

- This figure indicates XRD relative intensity vs FWHM (rad) values as a function of rpm values. Results show the inverse relationship, which correlates with the crystallite size.

Surface Roughness

- CdO:Al/Silica Substrate Surface Roughness/ RPM

Energy Dispersive Spectra (EDX)

- CdO:Al thin film have successfully been deposited on silica substrates as a function of various rpm values using the Sol-Gel method.
- FT/IR confirms the presence of CdO:Al in the film with the peak position shifting to higher wavenumbers.
- XRD result indicates the highest crystallinity at 6000 rpm with a crystallite size of 31.845 nm, cubic phase formation, and strain of ~1.6 X 10^{-2}.
- FE-SEM/SEM/EDX shows the well-faceted structure at 6000 rpm having the average particle size of 130.05 nm.
- Surface roughness indicates a homogeneous surface at a higher rpm.

Conclusion

Acknowledgements

This work was supported by US Dept. of Education- The Minority Science and Engineering Improvement Program (MSEIP) (P120A220064) to Dr. Moniruzzaman Syed (Director) and Janice Slaughter (co-Director). Department of Physics, University of Memphis, TN and department of Chemistry, Villanova University, PA.