

Fabrication and Characterizations of Aluminum Doped Cadmium Oxide (CdO:Al) Thin Film using Sol-Gel Spin-Coating Method

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Introduction

Aluminum-doped cadmium oxide (CdO:Al) thin films are deposited on silica substrates by the sol-gel spincoating 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. thin films are characterized by x-ray CdO:Al 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 FE-SEM/SEM/EDX shows the well-faceted 10⁻². 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

Preparation of CdO:Al thin film



- Substrate Cleaning
- Preparation of Sol-Gel Precursor
- Preparation of Dopant
- > Thin Film Deposition







≻ Cadmium Oxide (CH3 COO)2Cd*2H2O), Aluminum Nitrate (Al(NO3)3*9H2O), 91% Isopropyl alcohol, Acetic acid (CH₃COOH) and Silica substrates



| el | | substrate and spun at variable RPM | |
|----|---------|---|---|
| | Layer 2 | 0.01 mL of CdO:Al sol gel dripped on silica substrate and spun at variable RPM | Substrate heated at 185 °C for 15 minutes |
| | Layer 3 | 0.01 mL of CdO:Al sol gel dripped on silica substrate and spun at variable RPM | Substrate heated at 400°C for 1 hour |

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)



Raman Scattering



Surface Roughness



CdO:Al/Silica Thin Film Particle Size

Distribution @ 6000 RPM

105

120

135

150 165

180

Average Particle Size 130.05 nm

X-Ray Diffraction (XRD)



Energy Dispersive Spectra (EDX) Field Emission Scanning Electron Microsc. (FE-SEM)



Conclusion

- > 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 $of \sim 1.6 X 10^{-2}$.
- ► 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.

