



# Optical and Structural Properties of Thermally Evaporated CdTe Thin Films

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## ABSTRACT

CdTe Thin films were deposited on silicon substrates by thermal evaporation method. The geometric thickness was calculated using interferometric method based on reflectance curve recorded with the spectrophotometer. The Reflection of High-Energy Electron Diffraction (RHEED) patterns and XRD analysis reveals that the structure of the films are polycrystalline with preferential orientation (111). The structure constant ( $a$ ), crystallite size ( $D$ ), dislocation density ( $\delta$ ) and strain ( $\epsilon$ ) were calculated, and it is observed that the crystallite size increases but micro-strain and dislocation density decreases with increases in thin film thickness. The composition of the samples was determined by Energy Dispersive X-ray Analysis (EDX) and it is found that the wt.% of Cd increases and the wt.% of Te decreases with the increases of film thickness due to the re-evaporation of Te.

**Key word:** CdTe thin film, Thermal evaporation, RHEED, EDX, XRD.

## -1

2-6

(photo-electrochemical )  
 (detectors) (field effect transistors)  
 (photoconductors) (photodiodes)  
 .[1-2] (photo voltaic solar cells)

CdTe

2-6

(1.5 eV)

[3].

(molecular beam epitaxy) (vacuum evaporation)  
 [4-5] .(Pulse Laser Ablation (PLD))

(cubic zincblende structure)

. (hexagonal wurtzite structure)

[6] (RF-sputtering)

(111)

CdTe

.(220)

[10]

[7-9]  
(PLD)

[3]

(311) (220) (111)

(111)

CdTe

**-2**

99.999 %

CdTe

coating system (EDWARD-610-A)

(I=70A)

80%

)

(20%

(3\*10<sup>-</sup>

(HT (2 KV, 160 mA))

<sup>5</sup>mbar)

(0.4 nm/s)

150°C

**-3**

:

**1-3**

(n<sub>f</sub>=2.6)

(n<sub>s</sub>=3.2)

λ

.π

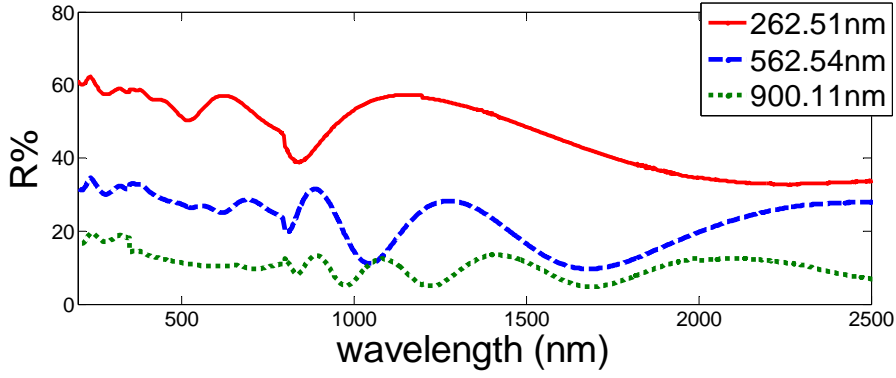
(

)

)

800 nm

(  
800 nm λ



.CdTe

(1)

[11-13] :

$$d = \frac{m}{2D_n \sqrt{(n^2 - \sin^2 \theta^2)}}$$

:m :d :  
:D<sub>n</sub> :θ

:(structural analysis) 2-3

:(XRD) 1-2-3

(D) .(λ=1.5406 Å) Cu k<sub>α</sub> (XRD)

[14-15] :Scherrer

$$D = \frac{0.94\lambda}{\beta \cos \theta}$$

.(FWHM) :[14] (ε) (β) θ :

$$\epsilon = \frac{\beta \cos \theta}{4}$$

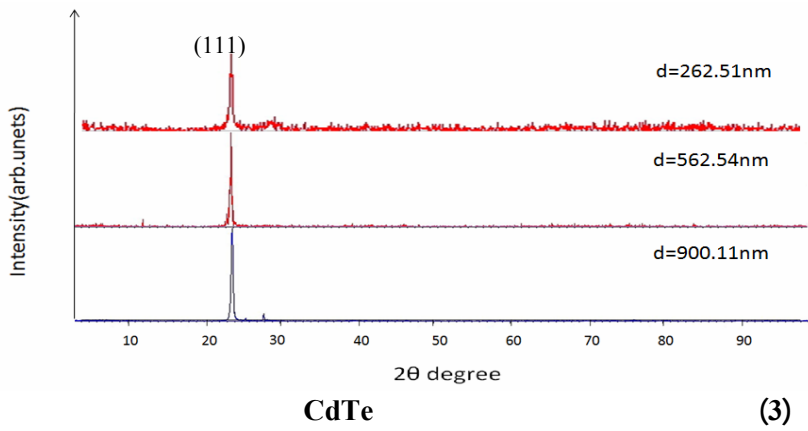
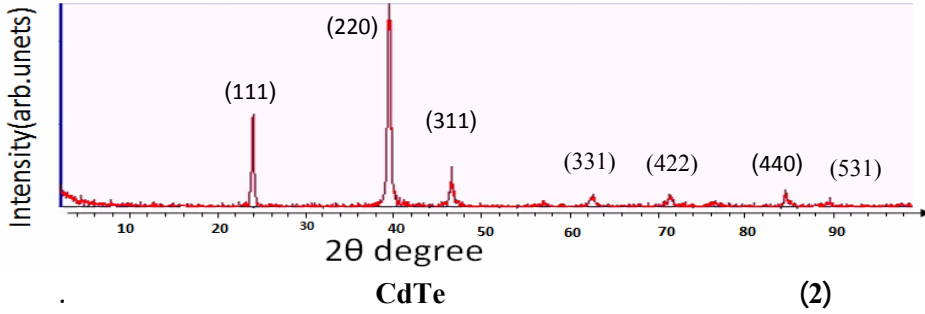
: [9] (δ)

$$\delta = \frac{1}{d^2}$$

: [1,14]

$$a = d\sqrt{h^2 + k^2 + l^2}$$

h,k,l :



(111)

CdTe (2)

84.46 76.30 71.21 62.35 56.82 46.43 39.31 23.7=2θ .89.41  
(400) (311) (220) (111) (531) (440) (511) (422) (331)

$$2\theta = 23.7^\circ \quad (3)$$

(111) CdTe [16].

(FWHM)

(internal micro-strain) ( $\epsilon$ )

[17].(D)

(1)

CdTe

(1)

Film thickness (nm)	d spacing (nm)	Lattice parameter (a) (nm)	$\beta$ (FWHM) ( $2\theta=23.7$ )	Crystallite size (D) (nm)	Micro-strain ( $\epsilon$ ) $\times 10^{-3}$	dislocation density ( $\delta$ ) $\times 10^{-4}$ (lin/nm <sup>2</sup> )
262.51 nm	0.3720	0.6443	0.357	23.4	1.5424	0.1816
562.54 nm	0.3744	0.6484	0.270	31.39	1.1528	0.1014
900.11 nm	0.3754	0.6502	0.228	37.14	0.9744	0.0724

:(RHEED)

2-2-3

(RHEED)

CdTe

(RHEED)

(5) (4)

)

(d=900.11nm

(4)

(111)

(polycrystalline)

(5)

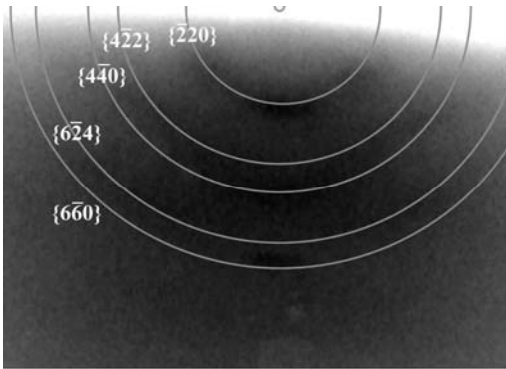
( )

(cluster

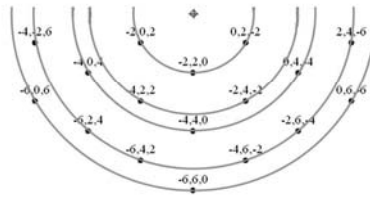
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[18-19] .[110]

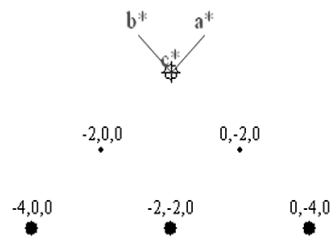
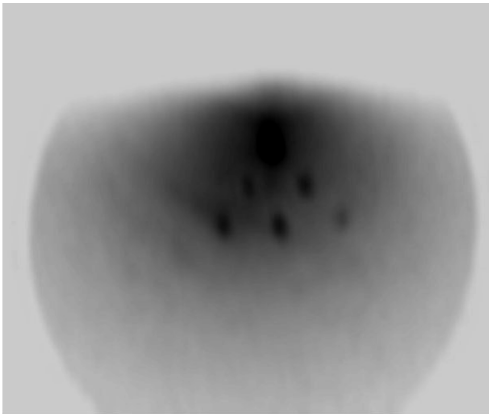
(CdTe)



) CdTe



(4)  
(d=900.11nm



[001]

(5)

:(Elemental analysis)

3-2-3

CdTe

Energy Dispersive X-ray

Oxford

(In Ga IV)

spectroscopy (EDX)

(VEGA 2 XMU) TESCAN

900.11 nm

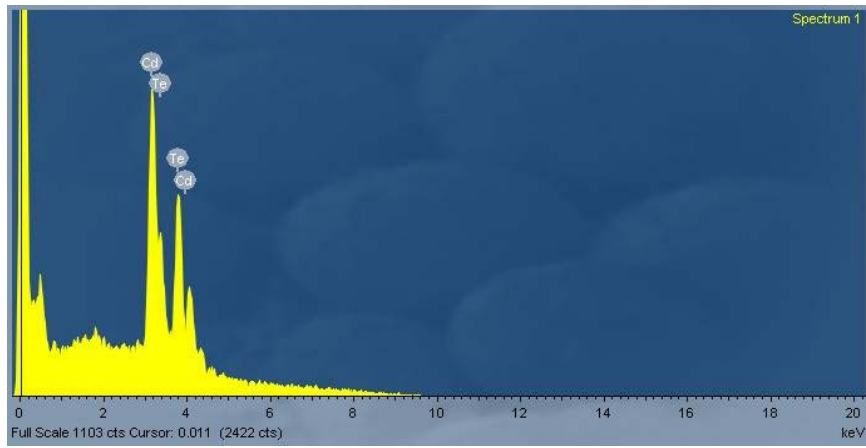
CdTe

(EDX)

(6)

[20].





CdTe

(2)

(2)

(T <sub>s</sub> =150°c)			
Te L (Atomic %)	Cd L (Atomic %)		
52.54	47.45	d=262.51 nm	(n-Si)
51.96	48.03	d=562.54 nm	
48.96	51.04	d=900.11 nm	

(2)

CdTe

(XRD)

(EDX)

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