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OPTICAL PROPERTIES OF KESTERITE PHASE $CU_2ZN_{0.8}CD_{0.2}SNS_4$ QUINTERNARY ALLOY NANOSTRUCTURES

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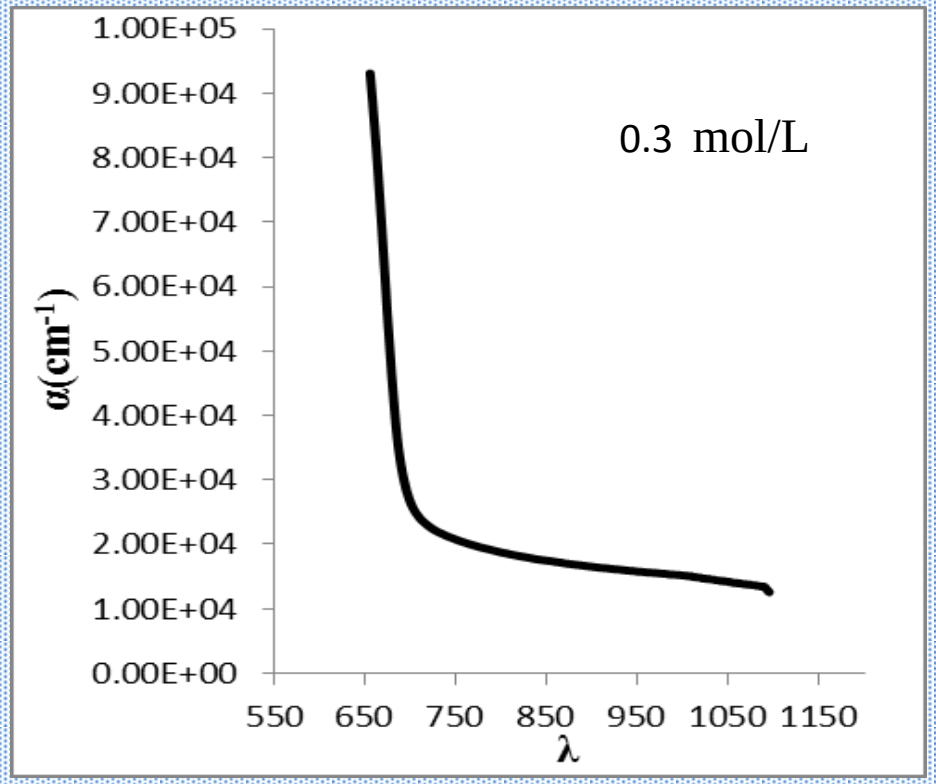
- **$Cu_2Zn_{0.8}Cd_{0.2}SnS_4$ quinternary alloy nanostructures were grown on glass substrate with different cooper (Cu) concentrations; 0.3, 0.5, 0.7 and 0.9 mol/L using spin coating technique. The direct band gap energy of $Cu_2Zn_{0.8}Cd_{0.2}SnS_4$ quinternary alloy nanostructures is investigated to decrease from 1.80 –1.60 eV as Cu increases. The transmittance value in the range 63-49% is depending on Cu content.**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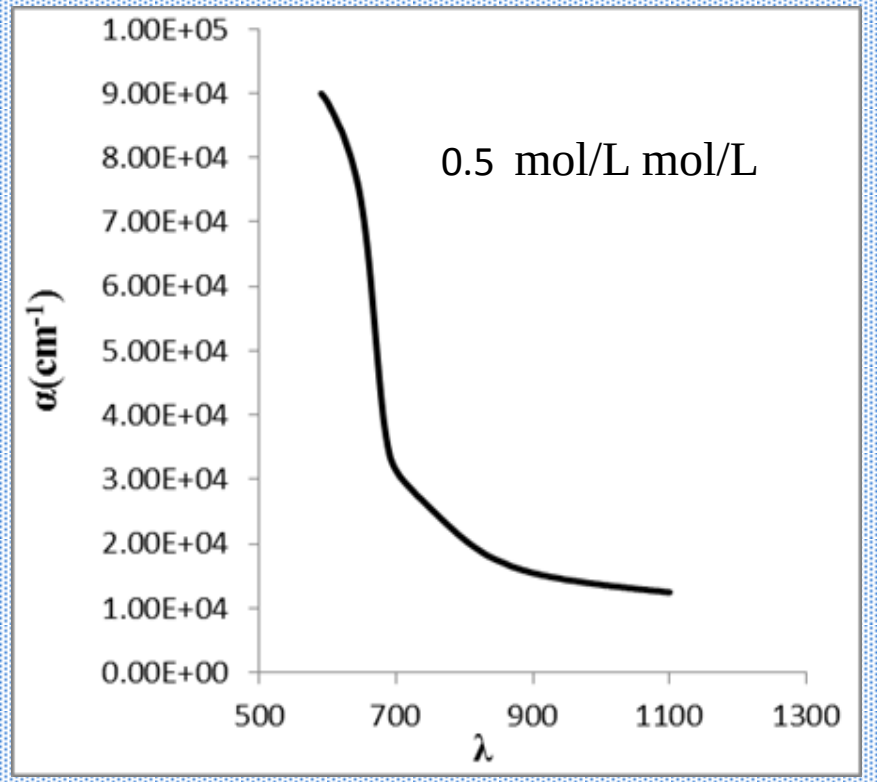
9.00E+04
8.00E+04
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
α(cm-1)
550 650 750 850 950 1050 1150
λ
0.3 mol/L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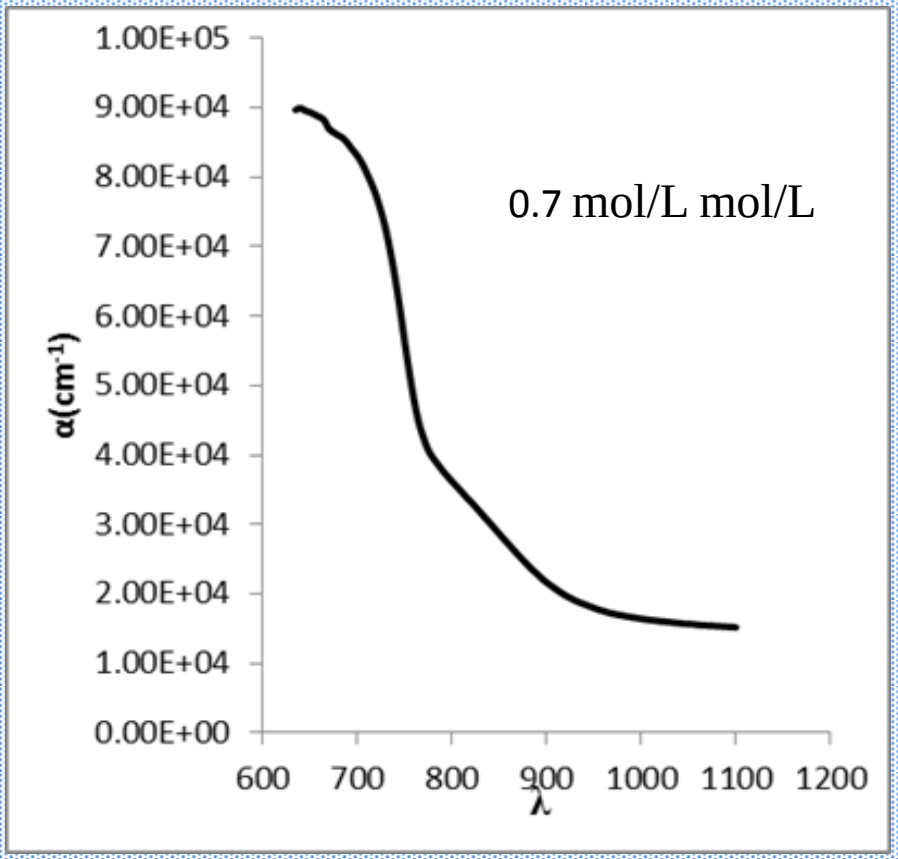
α(cm-1)
500 700 900 1100 1300
λ
0.5 mol/L mol/L



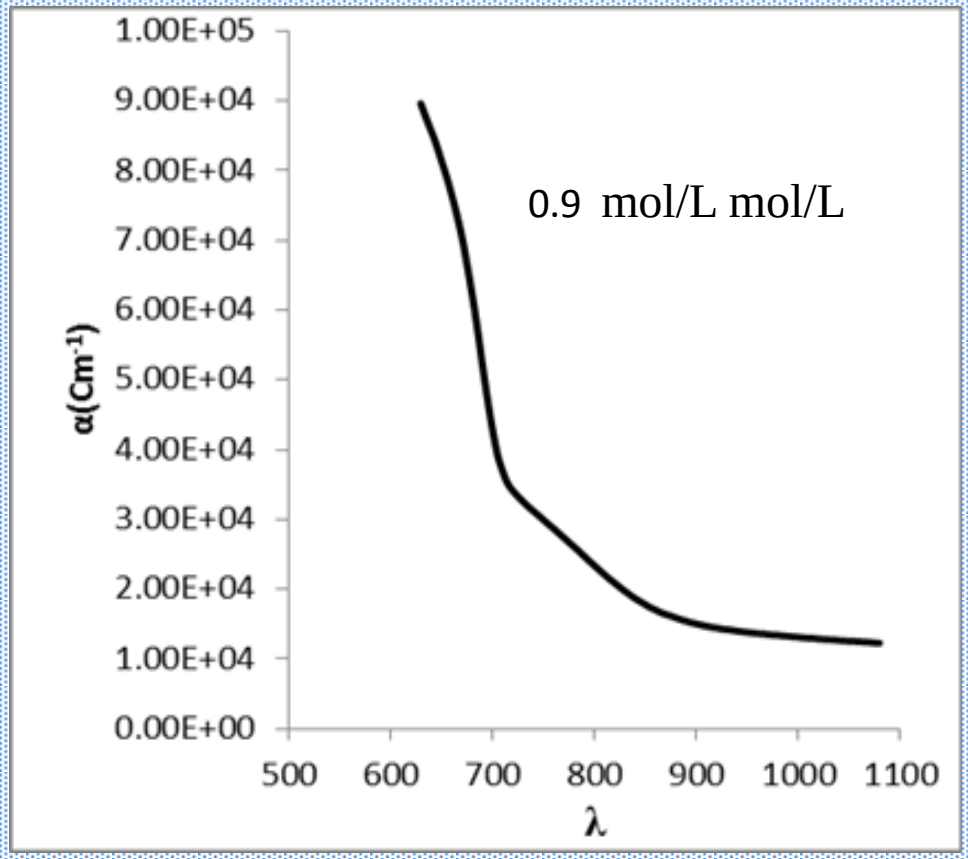
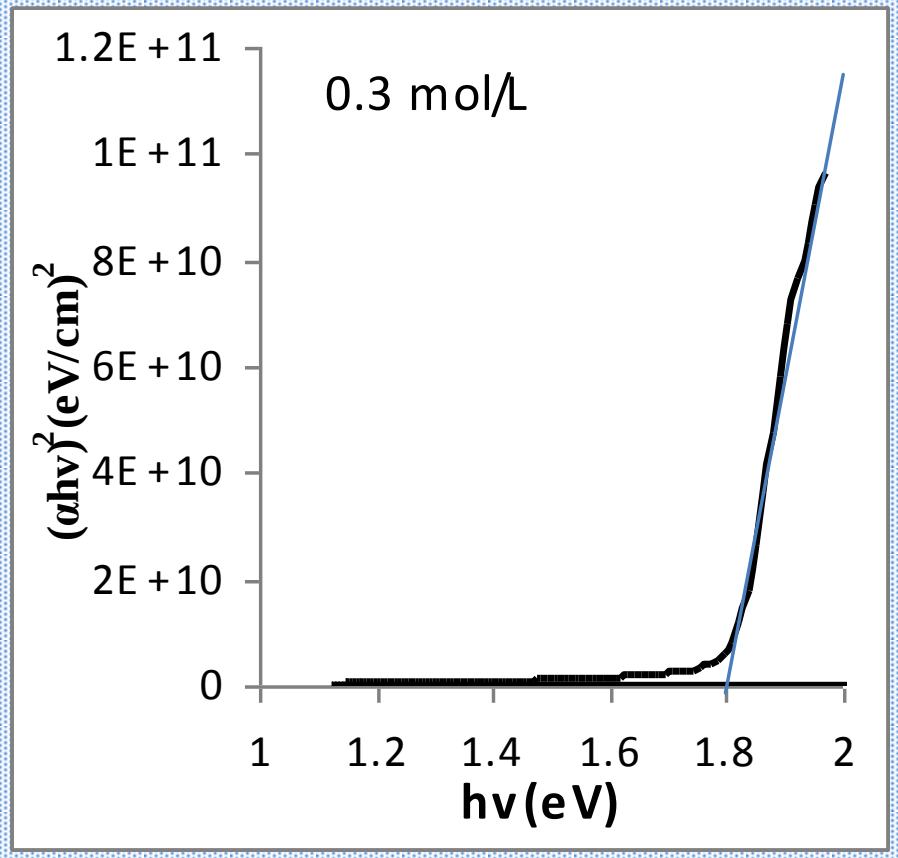
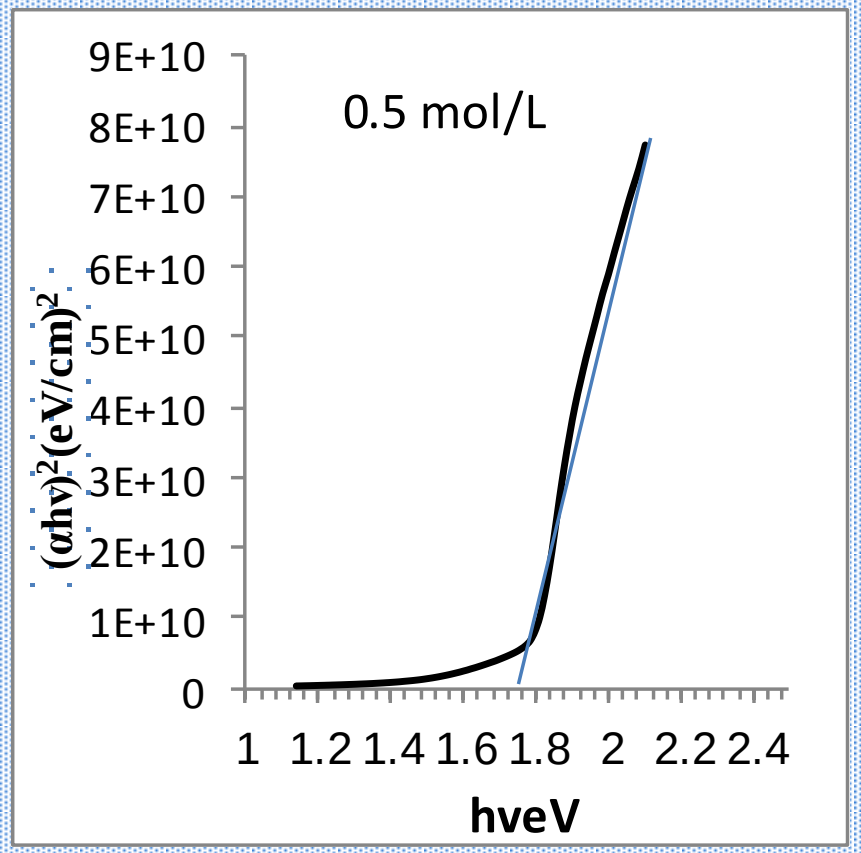


Fig 1 Optical properties of $Cu_2Zn_{0.8}Cd_{0.2}SnS_4$ quinternary alloy nanostructure for various Cu concentrations 0.3, 0.5, 0.7 and 0.9 Mol/L (a) The absorption coefficient


0.3 mol/L
1.2E+11
1E+11
8E+10
6E+10
4E+10
2E+10
0
(αhv)²(eV/cm)²
1
1.2
1.4
1.6
1.8
2
hv(eV)


0.5 mol/L
9E+10
8E+10
7E+10
6E+10
5E+10
4E+10
3E+10
2E+10
1E+10
0
(αhv)²(eV/cm)²
1
1.2
1.4
1.6
1.8
2
2.2
2.4
hveV

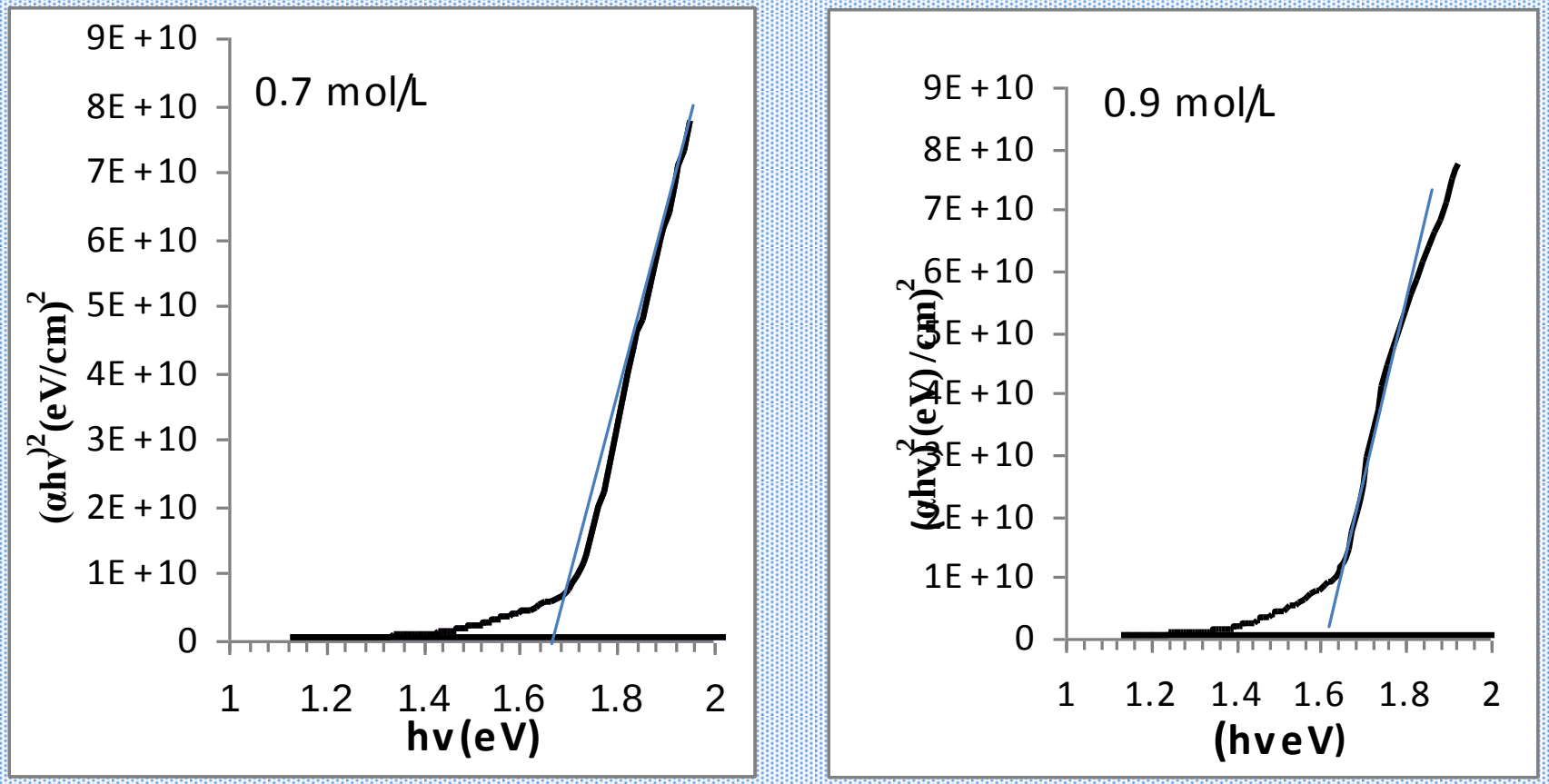


Fig 1 Optical properties of $Cu_2Zn_{0.8}Cd_{0.2}SnS_4$ quinternary alloy nanostructure for various Cu concentrations 0.3, 0.5, 0.7 and 0.9 Mol/L (b) Absorbance versus photon energy for determining the band gap.

- **Empirical models of n_o**

$n = \alpha + \beta E_g$ **Ravindra et al.**

$$n = \sqrt{1 + \left(\frac{A}{E_g + B} \right)^2}$$ **Herve & Vandamme**

$n^2 - 1 = A / (E_g + B)^2$ **Ghosh et al.**

Table 1 Optical band gap corresponds to refractive index and optical dielectric constant using Ravindra et al. [18], Herve and Vandamme [19], and Ghosh et al. [20] models of $Cu_2Zn_{0.2}Cd_{0.8}SnS_4$ quinternary alloy nanostructures deposited at different different mol/L.

Molar concentration (mol/L)	E_g (eV)	n	ε_∞
0.3	1.8	2.93^a 2.80^b 2.68^c	8.58^a 7.84^b 7.18^c
0.5	1.76	2.95^a 2.81^b 2.70^c	8.70^a 7.89^b 7.29^c
0.7	1.68	3.00^a 2.85^b 2.72^c	9.00^a 8.12^b 7.39^c
0.9	1.6	3.05^a 2.89^b 2.75^c	9.30^a 8.35^b 7.56^c

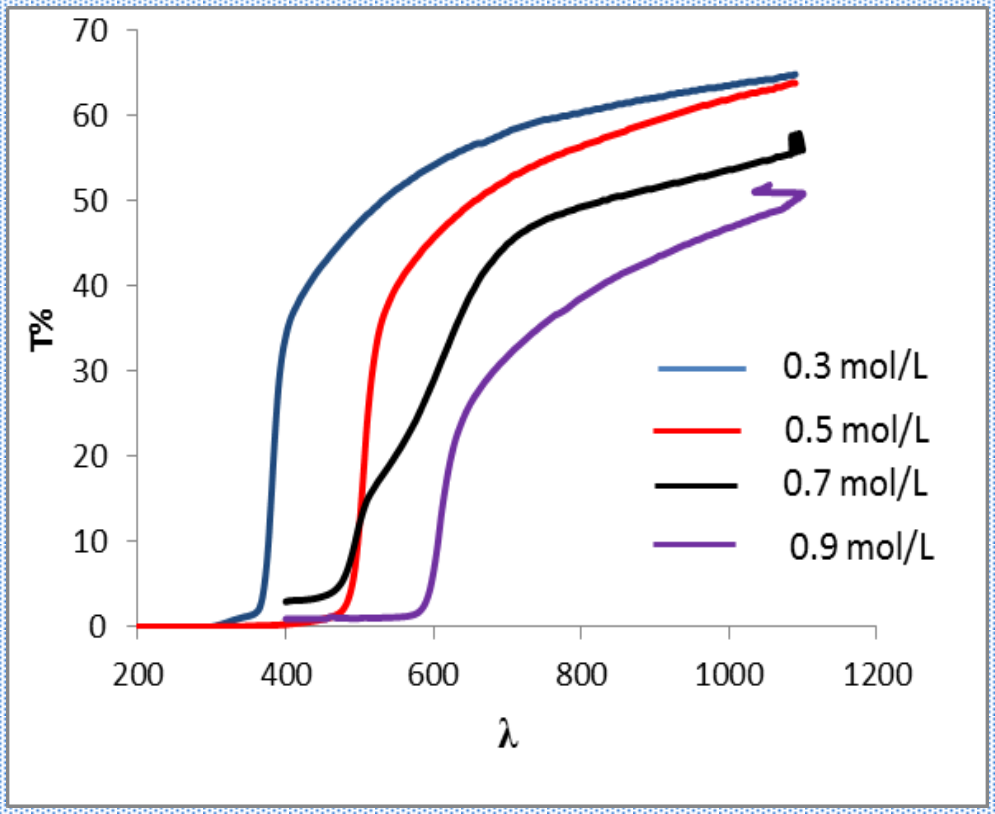


Fig. 2 Transmittance spectra of $Cu_2Zn_{0.2}Cd_{0.8}SnS_4$ quinternary alloy nanostructures for various Cu concentrations 0.3, 0.5, 0.7 and 0.9 Mol/L.

- **CONCLUSION**

Spin coating technique proves capability to prepare precised nanostructures of $Cu_2Zn_{0.2}Cd_{0.8}SnS_4$ quinternary alloy. The observed band gap varies from 1.80 to 1.60 eV. The optical band gap energy decreases as Cu concentration increases showing red shift. The Transmittance decreases with increasing concentration of Cu that gives the preference for absorber layer fabrication. The refractive index and optical dielectric constant are calculated and recommend Ghosh et al model for solar cells applications.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