Table 14.1 CdTe optoelectronic and physiochemical properties

Property	Value or range	Reference
Optical band gap; E_g (300 K)	1.50 eV ± 0.01 eV	Single crystal [38] polycrystalline film [39]
Temperature dep: dE_g/dT	−1.7 meV/K	[40]
Electron affinity: χ_e	4.28 eV	[41]
Absorption coefficient (600 nm)	6×10^4/cm	[38, 39]
Index refraction: (600 nm)	~3	[42]
Static Dielectric constant: $\varepsilon(\theta)$	9.4, 10.0	[41, 43]
High Freq. Dielectric constant: $\varepsilon(\infty)$	7.1	[43]
m_e^*	0.096	[44]
m_h^*	0.35	[44]
μ_e	500–1000	[44]
μ_h	50–80	[44]
Space group	F-43 m	[45]
Lattice parameter: a_o (300 K)	6.481 Å	[45]
Cd–Te bond length	2.806 Å	Calculated from a_o
Density	~5.3	[42]
Heat of fusion: ΔH_f^o (300 K)	−24 kcal/mol	[46]
Entropy: S^o (300 K)	23 cal/deg-mol	[46]
Sublimation reaction	$CdTe \rightarrow Cd + 1/2Te_2$	[46]
Sublimation pressure: p_{sat}	$\log(P_s/\text{bar}) = -10\,650/T(\text{K}) - 2.56 \log(T) + 15.80$	[46]
Melting point	1365 K	[44]

10^{-5} Torr and for CdS, $\Delta H_f = -30$ kcal/mol and $p_{sat}(400^\circ\text{C}) = 10^{-7}$ Torr [46]. The equilibrium reaction for CdTe solid and Cd and Te vapors is

$$Cd + 1/2Te_2 \Leftrightarrow CdTe$$

The CdTe temperature versus composition, T–x, atmospheric pressure phase diagram is shown in Figure 14.3(a). The individual vapor–solid equilibria for CdTe, CdS, Cd, Te, and $CdCl_2$ are shown in Figure 14.3(b) over the temperature range employed for fabricating solar cells, from 100 to 600°C. Congruent evaporation of CdTe facilitates vapor-deposition techniques, and the comparatively high sublimation pressures for Cd and Te ensure single-phase composition in deposits formed in vacuum at temperatures above ~300°C. CdTe is also the stable product of cathodic reduction from solutions containing Cd and Te ions due to the reasonably close reduction potentials for Cd and Te and the low solubility product of CdTe.

The T–x phase equilibrium of the CdTe system at atmospheric pressure is characterized by Cd ($x = 0$) and Te ($x = 1$) endpoints and by the compound CdTe (Figure 14.3a). Note that the CdTe melt temperature, $T_m = 1092^\circ\text{C}$, is significantly higher than for either