P and N-type doping of single crystal CdTe, CdSeTe

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Major Considerations

- Dopant solubility, stoichiometry condition

- Depth from band edges (20-100 meV)
  P-type: Na_{Cd}, P_{Te}, As_{Te}
  N-Type: In_{Cd}, Al_{Cd}, Cl_{Te}, I_{Te}

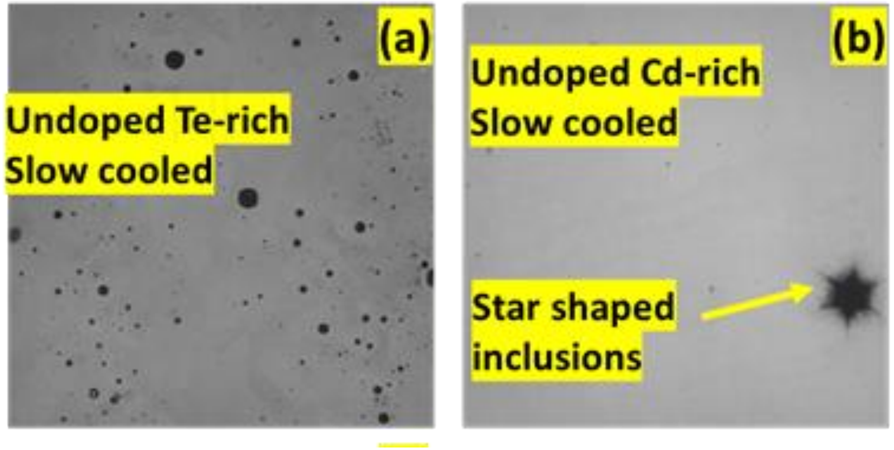
- Compensation: Native defects, complexes, unintentional impurities, AX or DX centers

- Stability

Doping in melt growth, stoichiometry, secondary phases

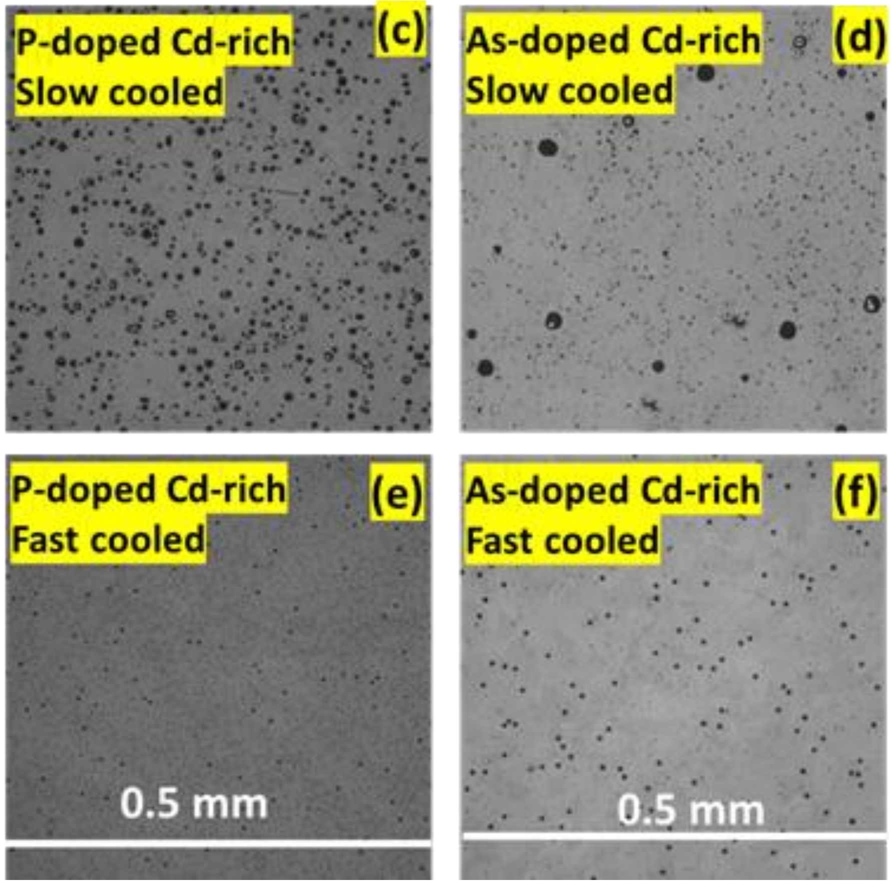
Melt grown crystals

Undoped



IR micrographs

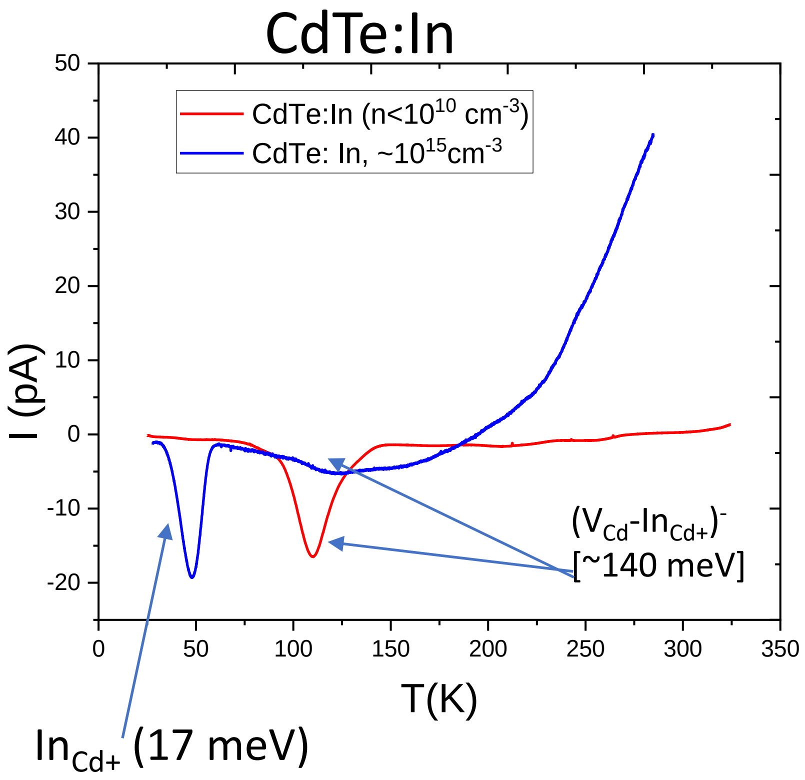
P and As doped



McCoy et. Al, Journal of Applied Physics **123**, 161579 (2018)

Compensating defects, A-center self compensation

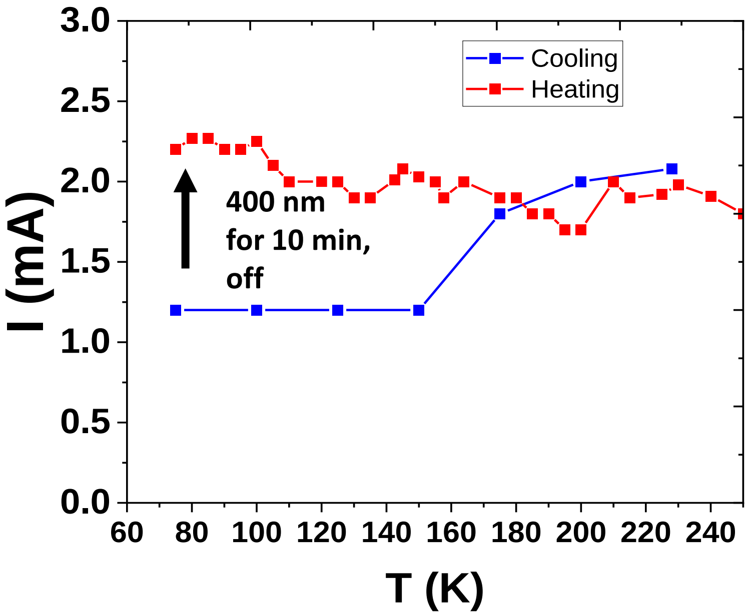
- Affects n-type doping by forming acceptor complexes with Cd vacancies
- Cd-annealing makes more n-type, for both site donors.

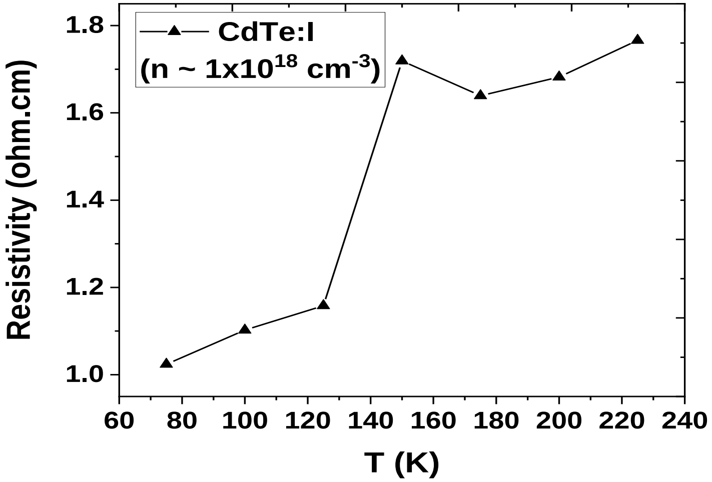


Thermoelectric spectroscopy on CdTe:In

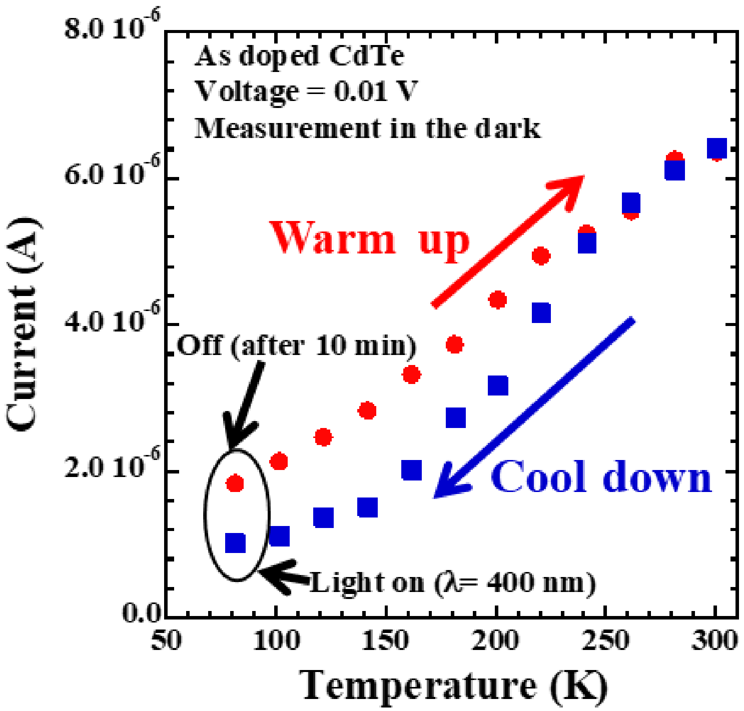
Compensating defects, AX, DX center

Iodine doping showing persistent current, n~ $10^{18}cm^{-3}$



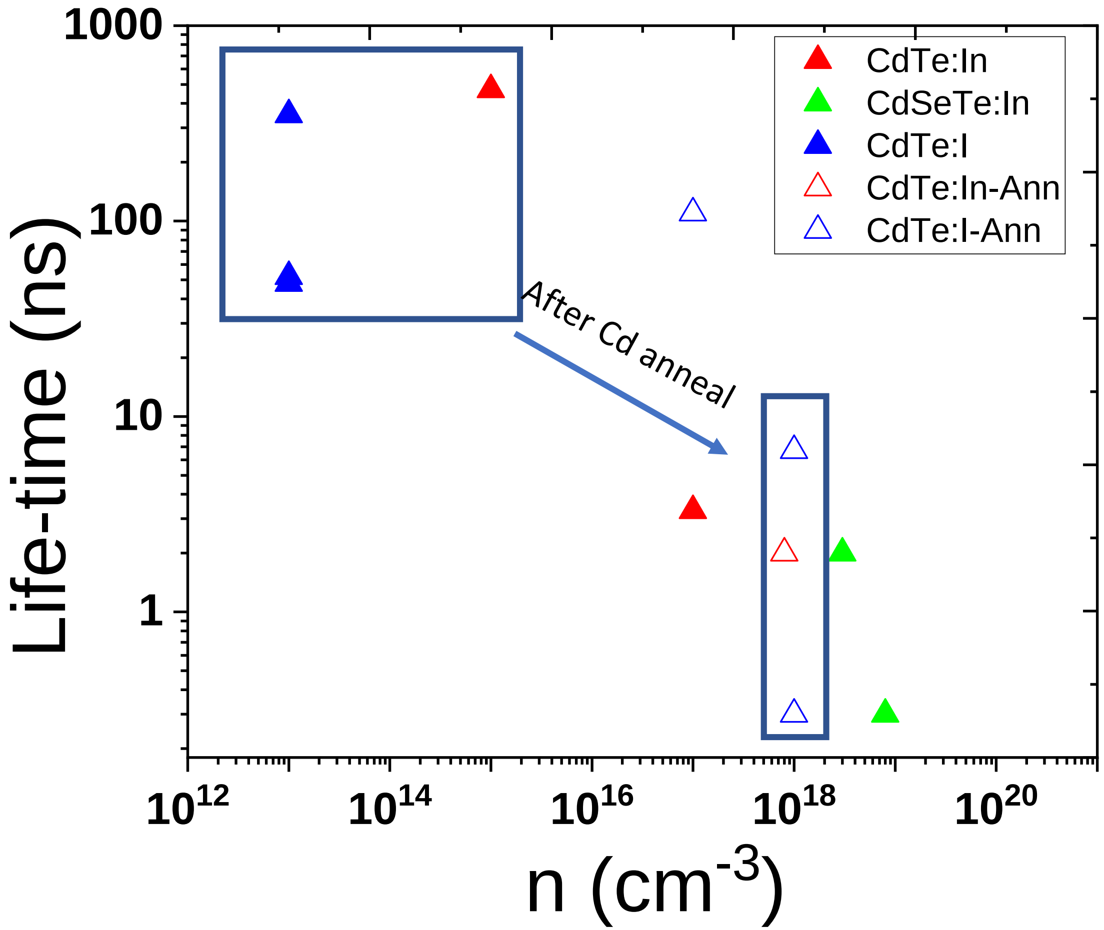


Arsenic AX center



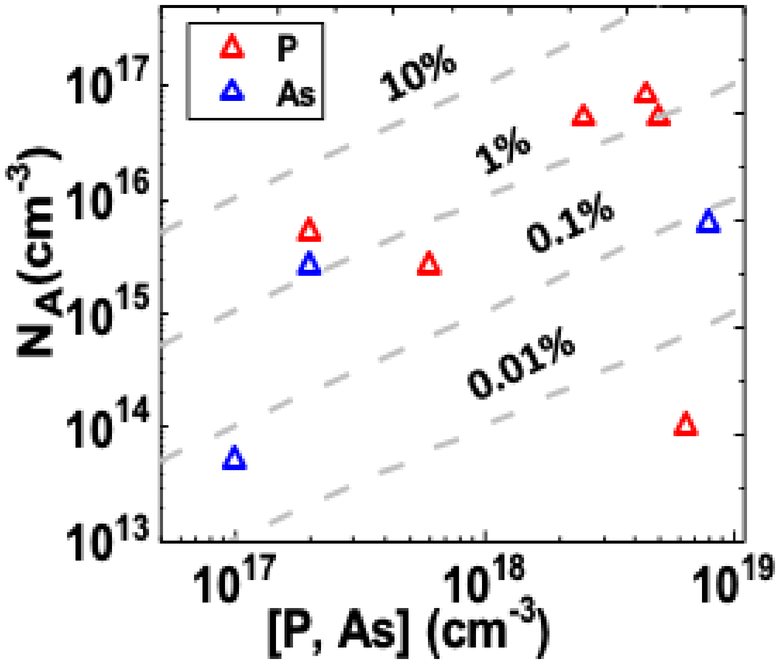
Nagaoka et. Al, Appl. Phys. Lett. **111**, 232103 (2017)

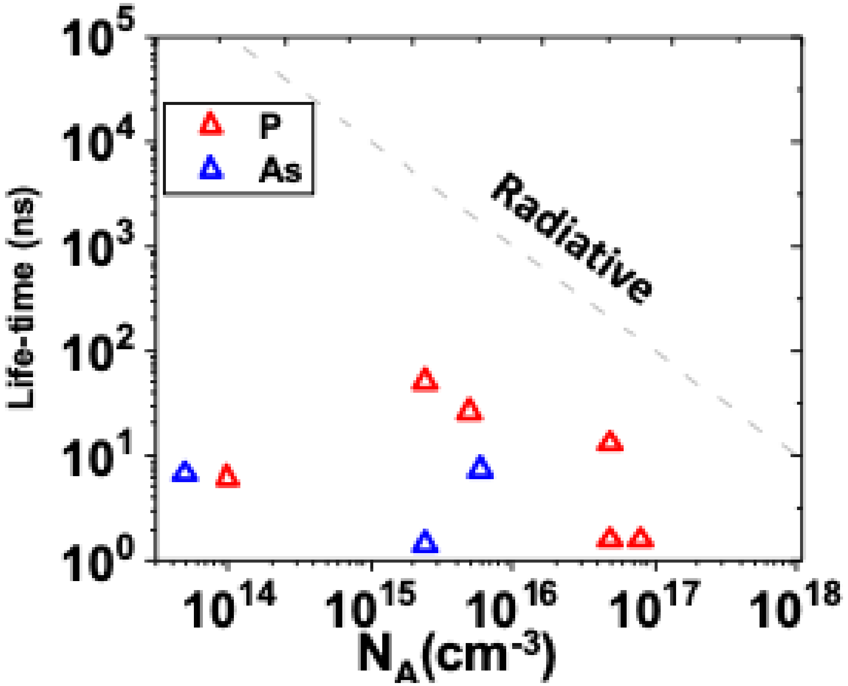
N-type doping summary



For n-type dopants in CdTe,n >10^{18} cm^{-3} is easily achievable, after Cd annealing, where as CdSeTe does not seem to require any anneals.

P-type doping summary





Hole density and life-time has been relatively inferior for As doping compared to P,

Growth methods incorporates melt convection showed better lifetime and doping efficiency, and could be attempted for other CdTe alloys including CdSeTe, in combination with Cd flux.