



Positron Annihilation Spectroscopy of Annealed CdZnTe/CdTe

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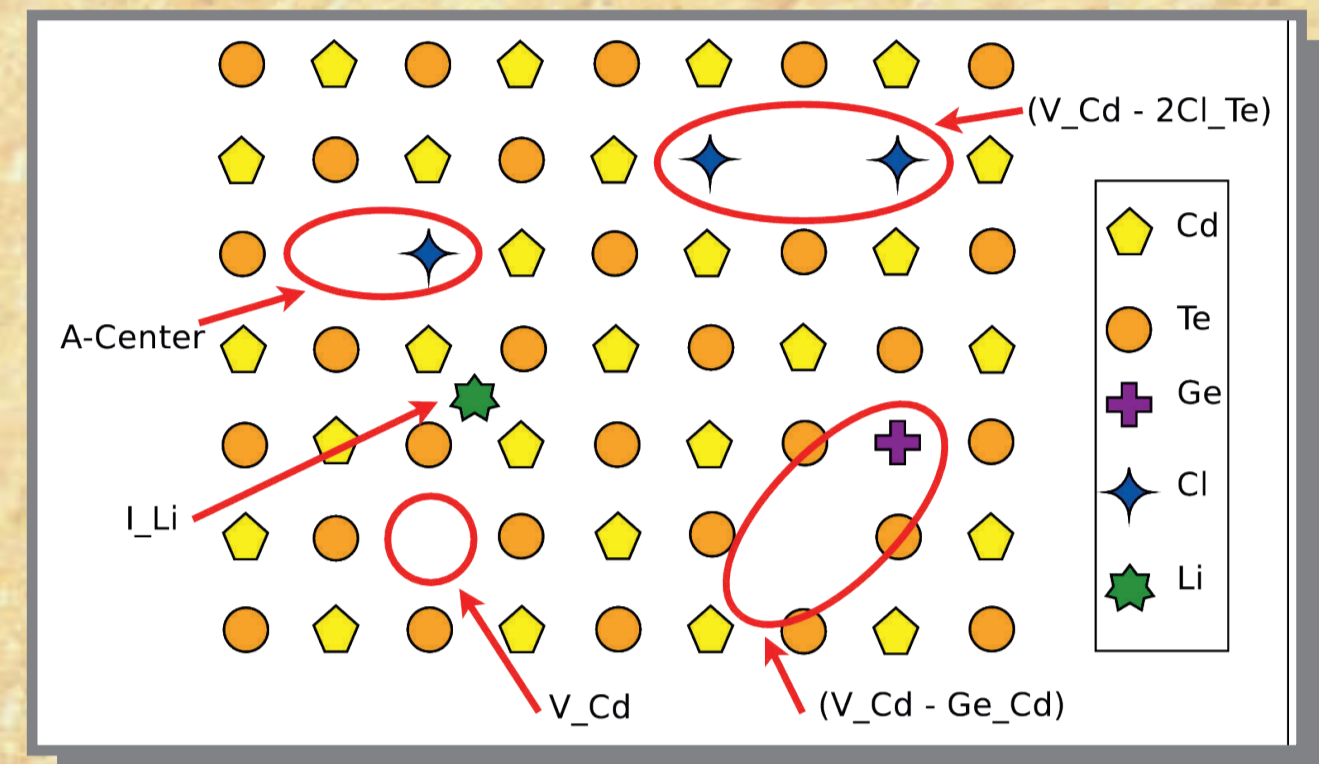
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1. Highlights

- Properties of Cd vacancy (V_{Cd}) represent a big puzzle in the CdZnTe/CdTe research. Despite big efforts in investigating its basic properties (e.g. formation and ionisation energies) in the last 50 years, it still remains undisclosed.
- In this presentation we study properties of V_{Cd} in CdZnTe:Ge and CdTe:Cl.
- All visible vacancies are coupled with donors-like defects ($V_{Cd}-X_D$) or ($V_{Cd}-2X_D$).
- First direct experimental confirmation of the effect of annealing to the vacancy in CdZnTe/CdTe.

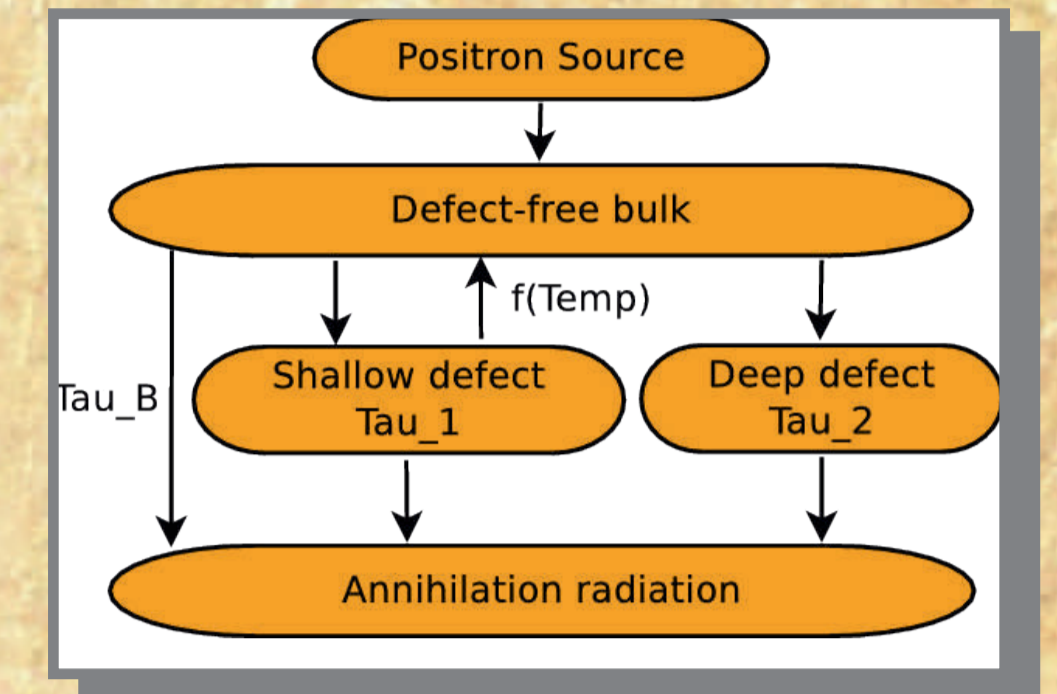
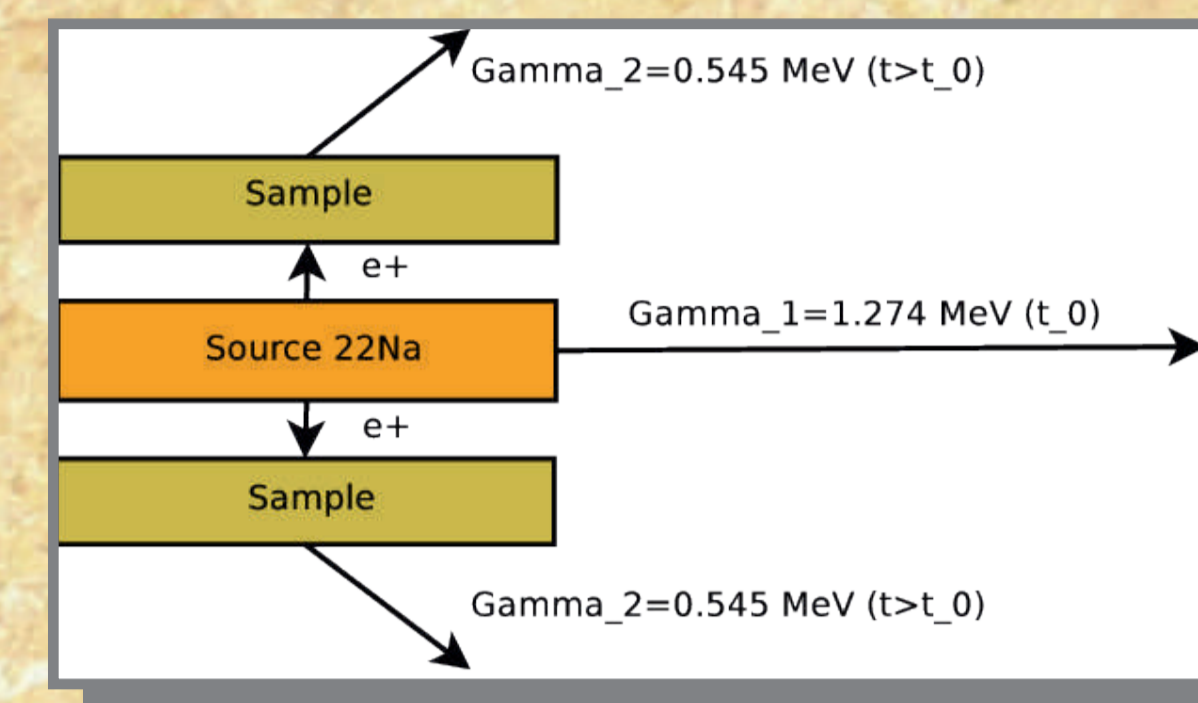
2. Point defects

- Vacancies
- Interstitials
- A-centers ($V_{Cd}-X_D$)
- Neutral ($V_{Cd}-2X_D$)



3. Experiment and Theory

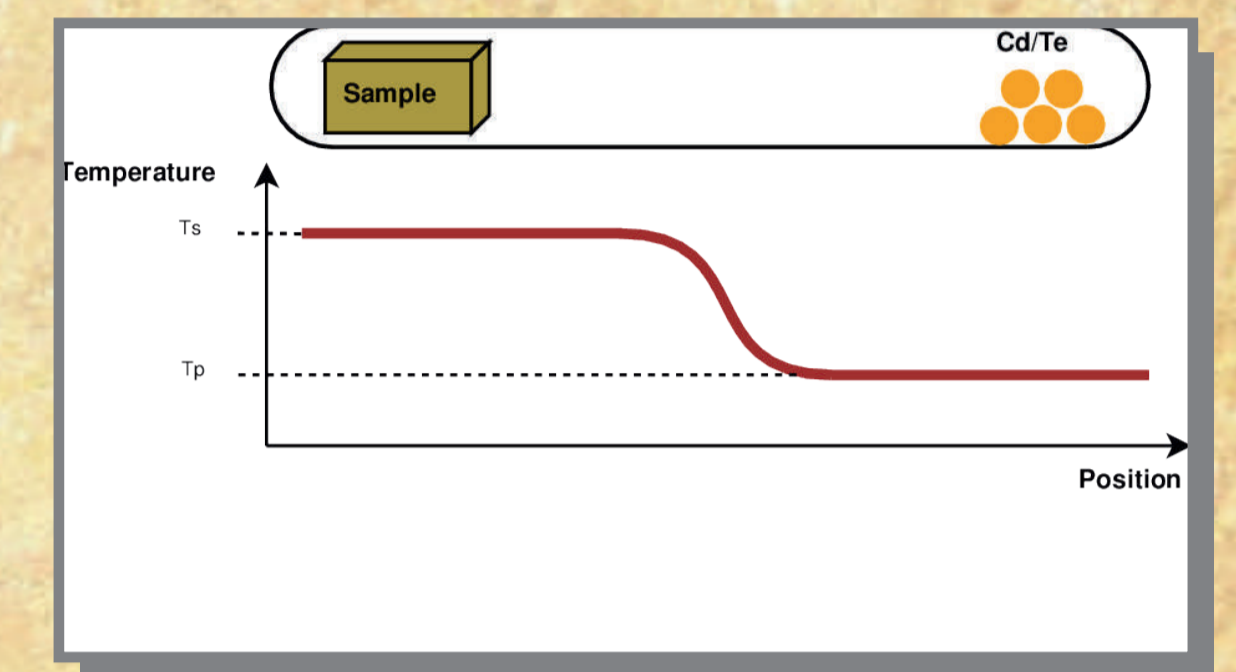
Positron annihilation spectroscopy



Annealing

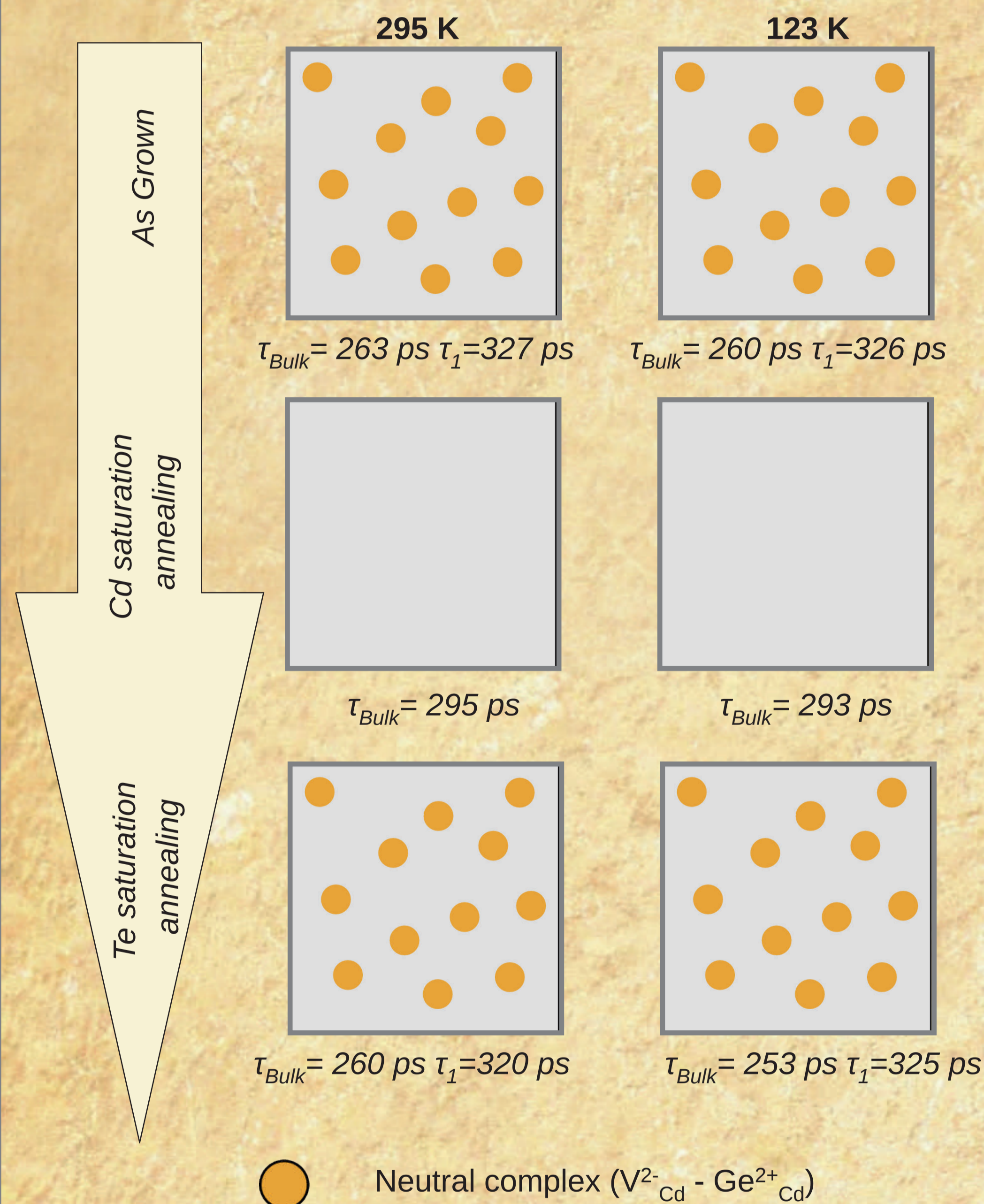
- Cd overpressure (700/600)
- Te overpressure (700/600)

Chemical Analysis (GDMS)



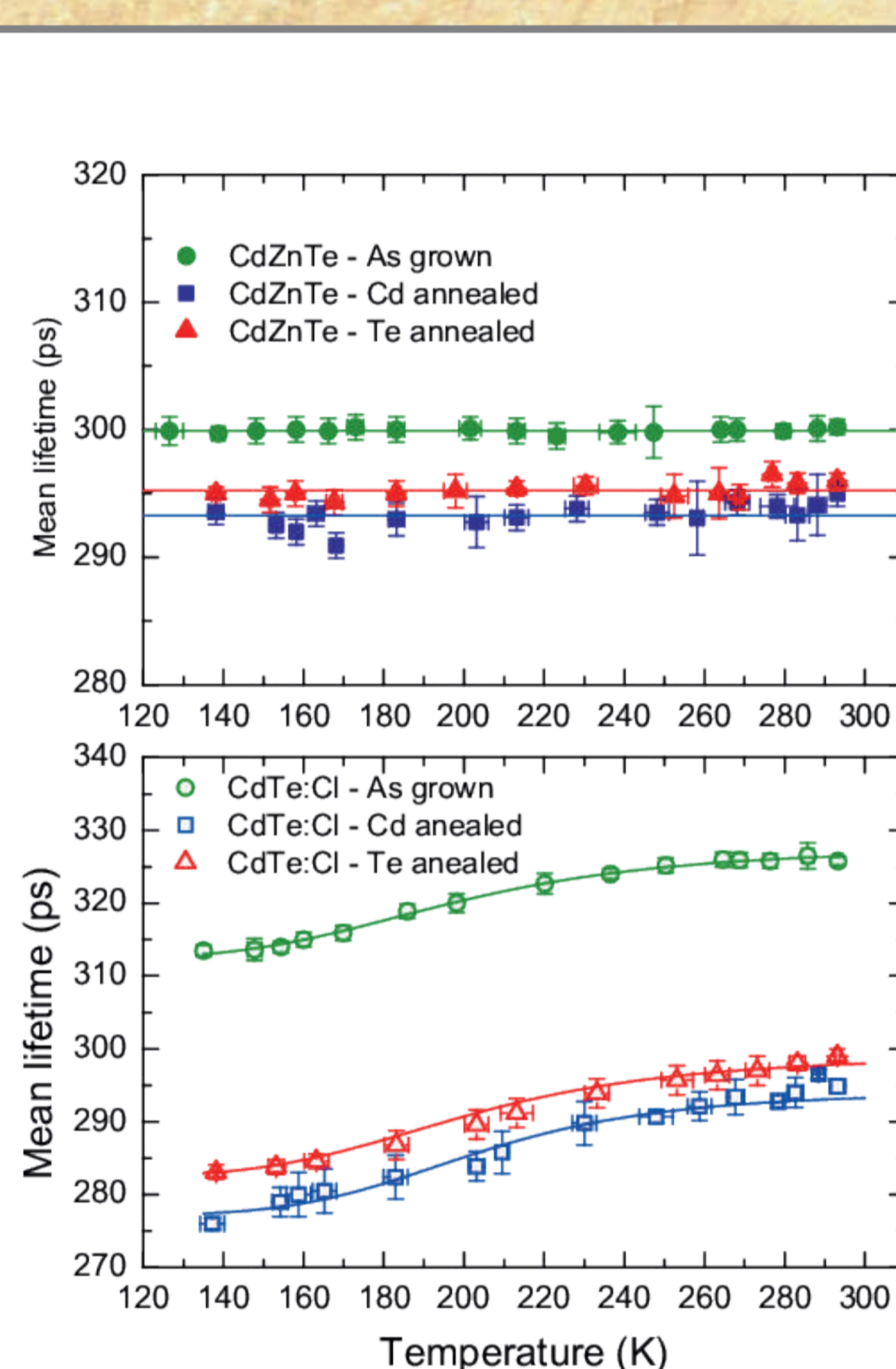
4. Results and Discussion

CdZnTe:Ge



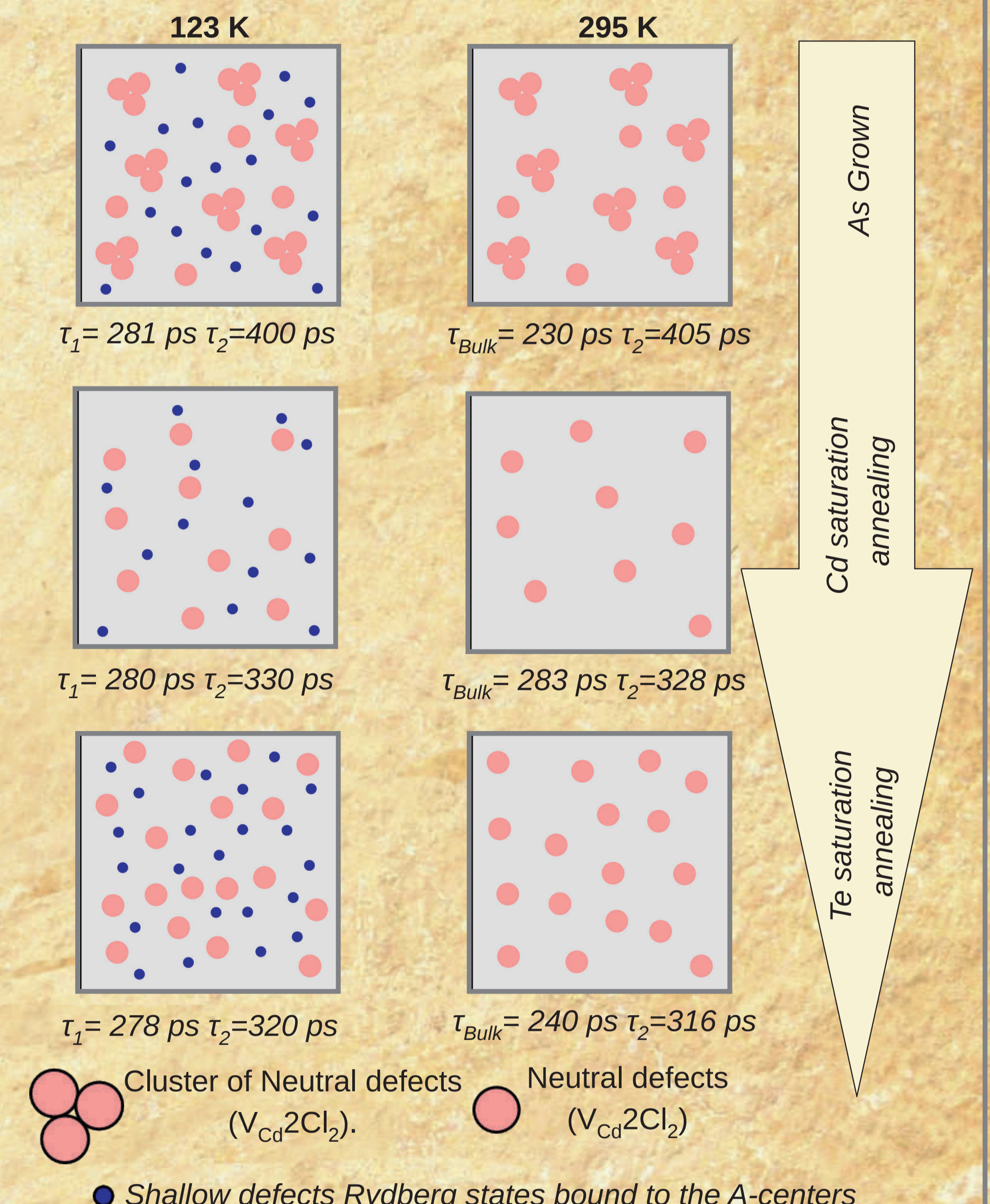
- Annealing CdZnTe at Cd pressure leads to decreasing of density of Cd vacancies below measurable level.
- Reannealing CdZnTe at Te pressure restores neutral defects ($V_{Cd}-Ge_{Cd}$) at material.
- There are no temperature activated shallow defects.

Temperature dependency of Mean lifetime

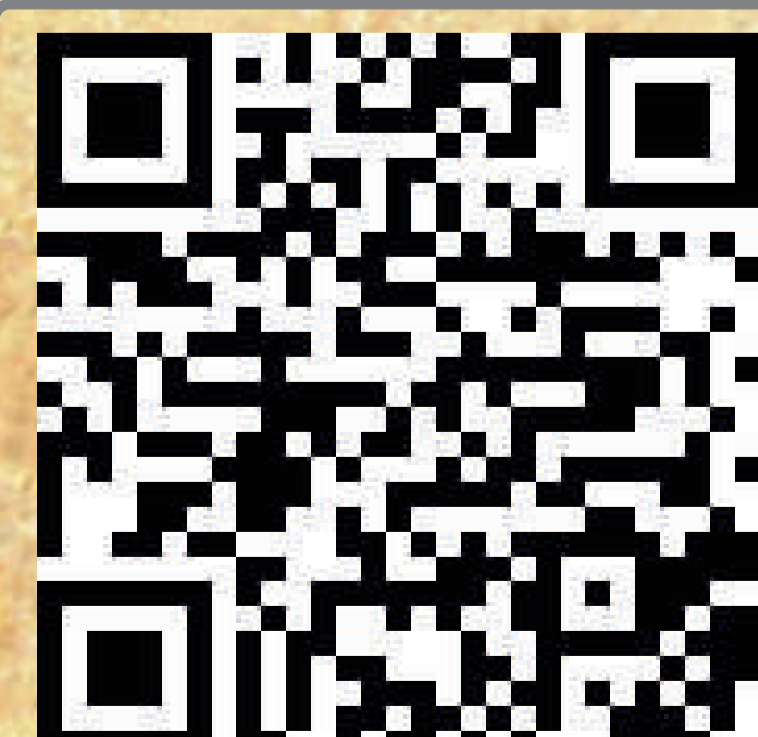


- CdZnTe doesn't contain any temperature activated shallow defects.
- CdTe:Cl contains temperature activated shallow defects, which are major defects at low temperature (123 K).
- They are Rydberg states around Chlorine A-centers.
- The concentration of this type of defects decreases during annealing at Cd overpressure and increases after Te annealing.

CdTe:Cl



- The CdTe:Cl contains neutral defects ($V_{Cd} 2Cl_2$) grouped in clusters.
- The CdTe:Cl contains Rydberg states bound to Chlorine A-centers visible in low temperature.
- Annealing CdTe:Cl at Cd pressure decreases the density neutral defects ($V_{Cd} 2Cl_2$) and Chlorine A-centers.
- Reannealing CdTe:Cl at Te pressure restored Cd vacancies forming single A-centers.



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References

- KRAUSE-REHBERG, R., et al.: Review of defect investigations by means of positron annihilation in II-VI compound semiconductors. Applied Physics A: Materials Science. 1998-6-1, vol. 66, issue 6, p. 599-614.

Summary

- The influence of annealing at CdZnTe:Ge and CdTe:Cl was shown. The same results like using standard galvanomagnetic measurements were obtained using PAS measurement technique. Cd annealing leads to decrease in density of Cd vacancies and A-centers and Te annealing restores these defects.
- As grown CdTe, doped by Cl, contains clustered defects and annealing procedures lead to unclustering of such defects.
- CdTe:Cl contains temperature activated shallow defects (Rydberg states around Chlorine A-centers), which are major defects at low temperature.