

Study of cluster related effects in n-irradiated Epi-Do and MCz diodes

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Aims

Topic 1.

- Correlation of current and cluster related defects

Observation by Fleming et al.

Bistability of cluster related defects

→ Recovery of cluster defects after injection of forward current

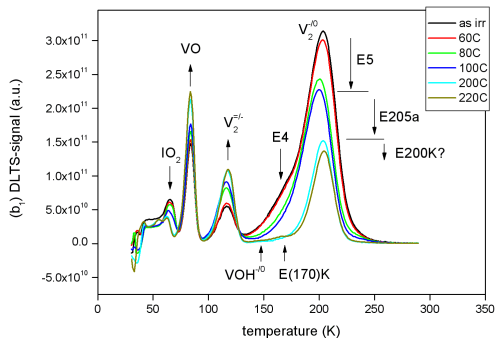
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Topic 2.

- Characterisation of bistable effect
- Characterisation of cluster related defects

Isochronal annealing up to 220 °C

DLTS spectra



MCz

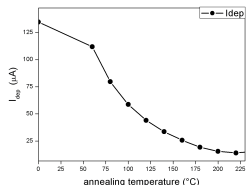
- 300 μm
- $3 \times 10^{11} \text{ n/cm}^2$

Concentrations obtained via

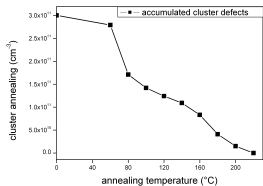
- Maxima analyses
- fitting
- difference figures

Current annealing \Leftrightarrow cluster annealing

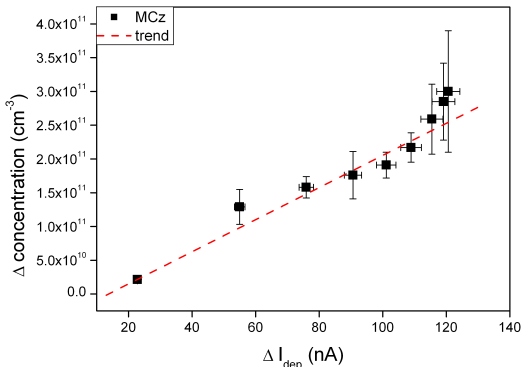
Current at full depletion



Accumulated clusters



Correlation



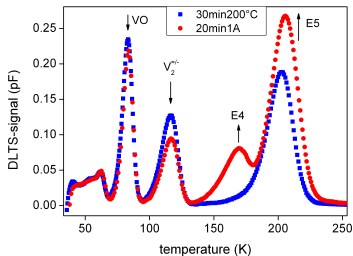
Current and cluster annealing are correlated!

Further treatment

Observation by Flemming et al.

Bistability of cluster related defects after injection of forward current

Changes in DLTS after injection



Treatment

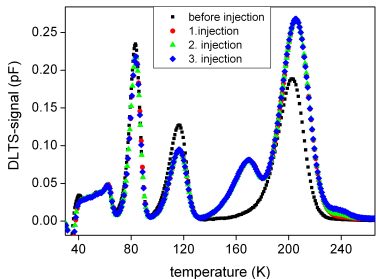
- 1 Isochronal annealing step
- 2 Injection of 1A
- 3 Isothermal annealing

Measurements

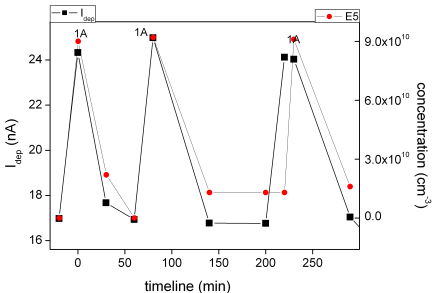
- CV/IV
- DLTS/TSC after each step
- capture measurements

Stability of bistable effect

MCz at 30 minutes at 200 $^{\circ}$ C



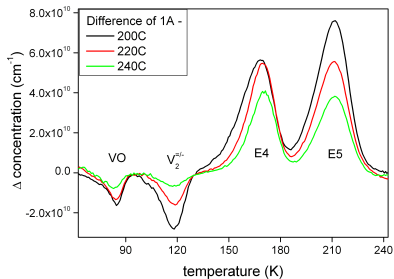
- Effect is reproducible



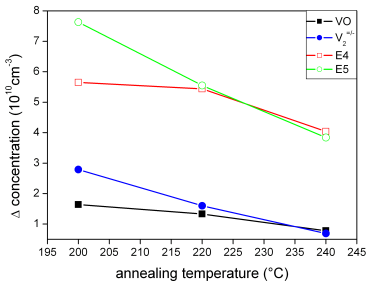
- I_{dep} behaves similar

Bistable effect at higher temperatures

Annealing steps of 200 °C, 220 °C and 240 °C



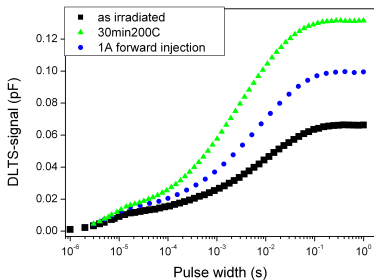
- cluster recovery diminished
- enhanced filling of VO and $V_2^{-/-}$



- decrease of E4 and E5 different
- possible correlation with point defects?

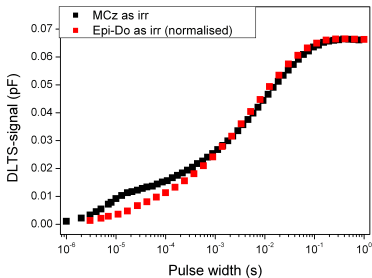
Capture measurements of ... $V_2^{=/-}$ as an example

MCz



- signal increase after annealing
- signal decrease after 20min 1A forward current

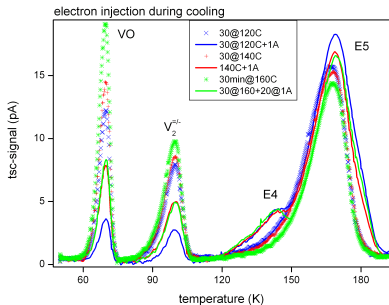
MCz & Epi-Do



- Epi-Do and MCz nearly identical

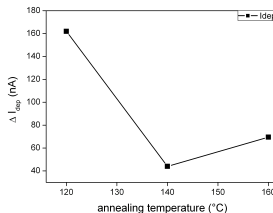
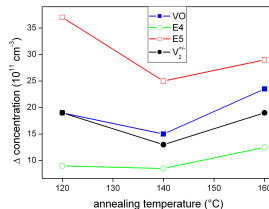
TSC-results on 1.6×10^{13} proton irradiated Epi-DO

Shows same situation like DLTS



- injection leads to increase of cluster related defects
- $V_2^{=/-}$ and VO suppression

Differences



Summary & outlook

summary

- Current and cluster related defects are correlated!
- Bistable effect on cluster related defects fully reproducible
- Filling of VO and $V_2^{=/-}$ reduced by cluster related defects

outlook

- Annealing temperatures up to 350 °C
- Characterisation of bistable effect
- Possible correlation of annealing point defects and reduction of bistable effect
- Position of Defects in cluster regions