COMPARISON OF SHALLOW DONOR FORMARION AND RADIATION DEFECT ELIMINATION IN HYDROGENATED PARTICLE DETECTORS MADE OF STANDARD AND DIFFUSION OXYGENATED SILICON

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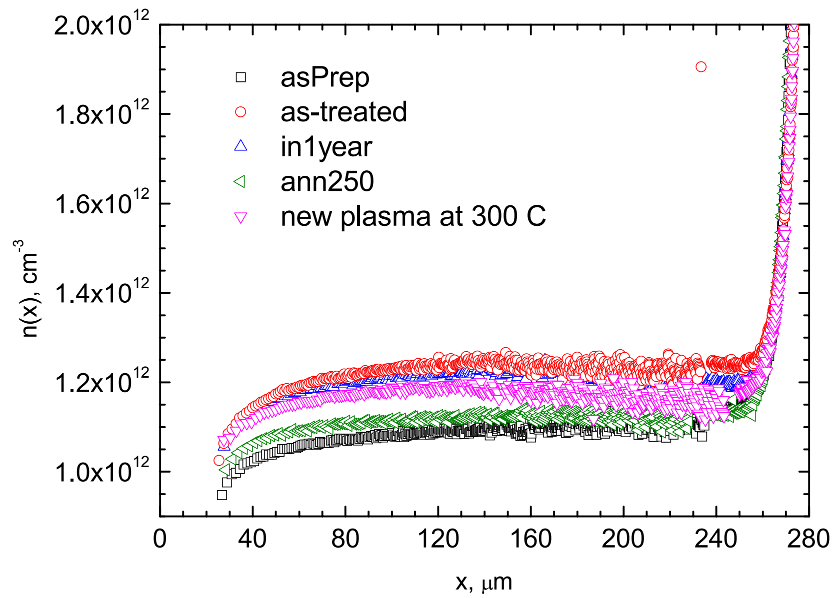


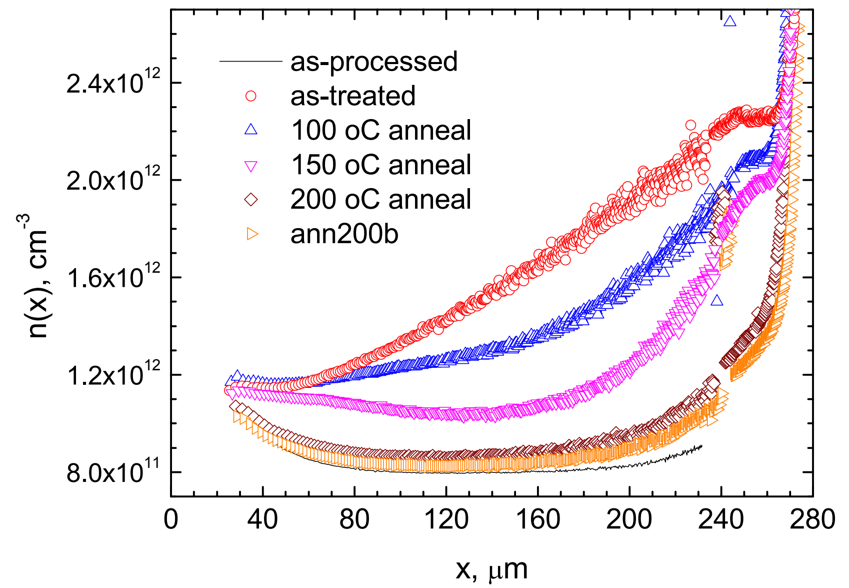


Fig 1. Annealing induced changes of the charge carrier distribution in the base region of standard (left) and oxygenated (right) FZ diodes treated in hydrogen plasma at 300 °C during 30 min .

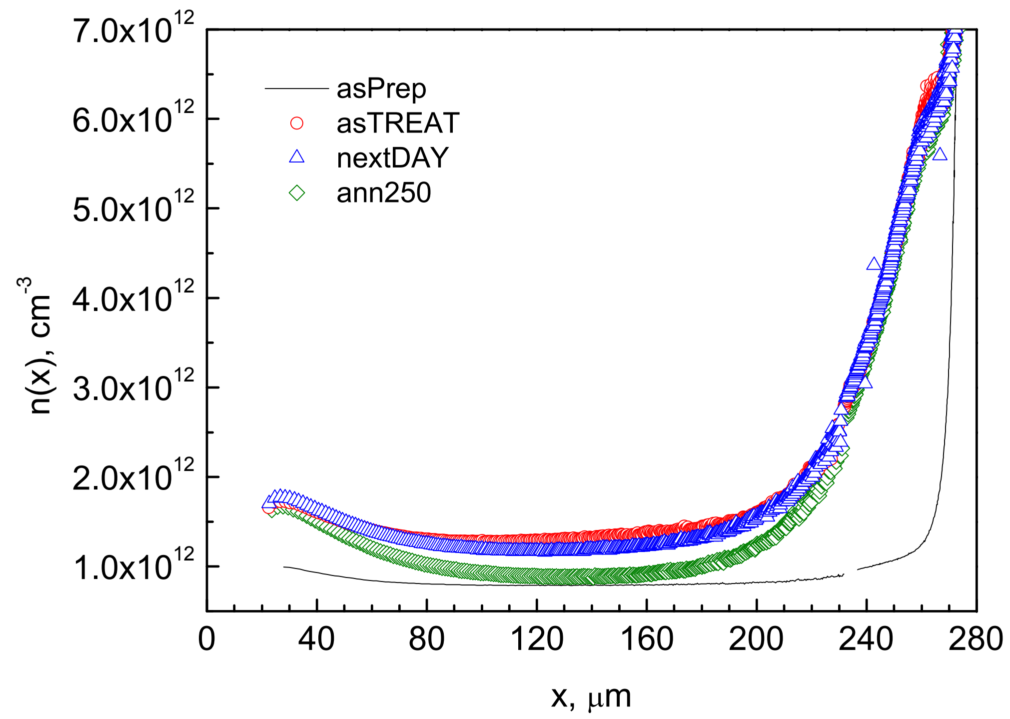


Fig 2. Annealing induced changes of the charge carrier distribution in the base region of oxygenated FZ diodes treated in hydrogen plasma at 325 °C during 450 min .

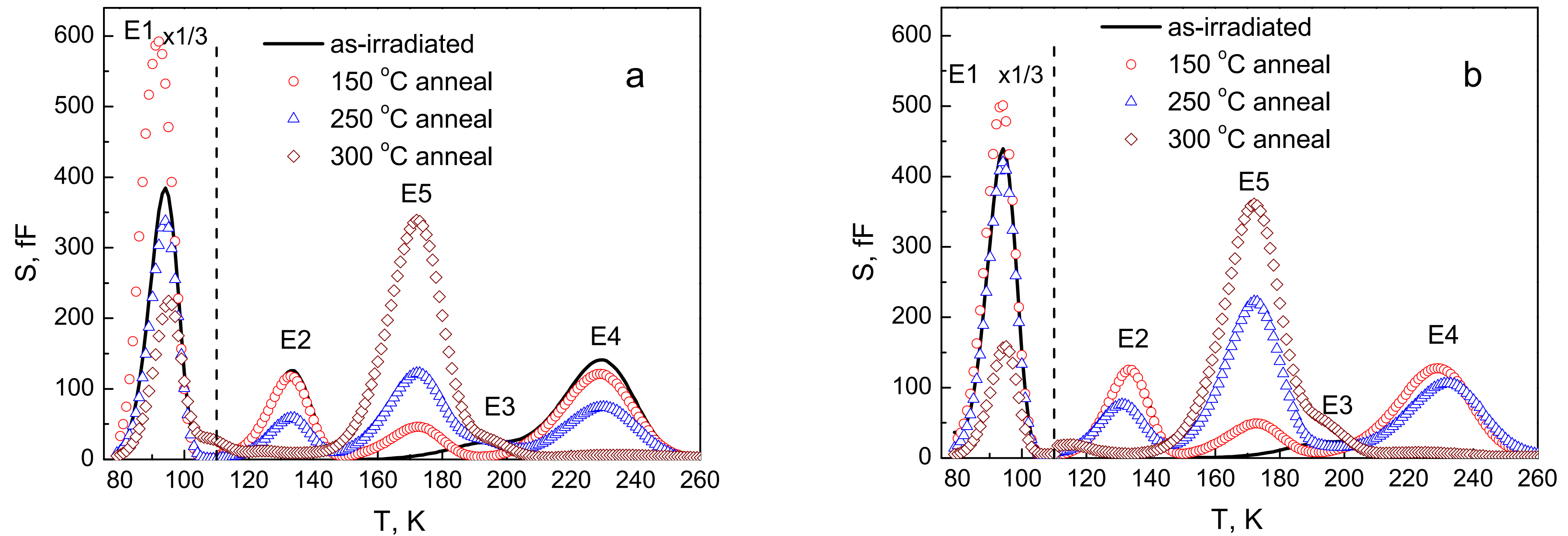
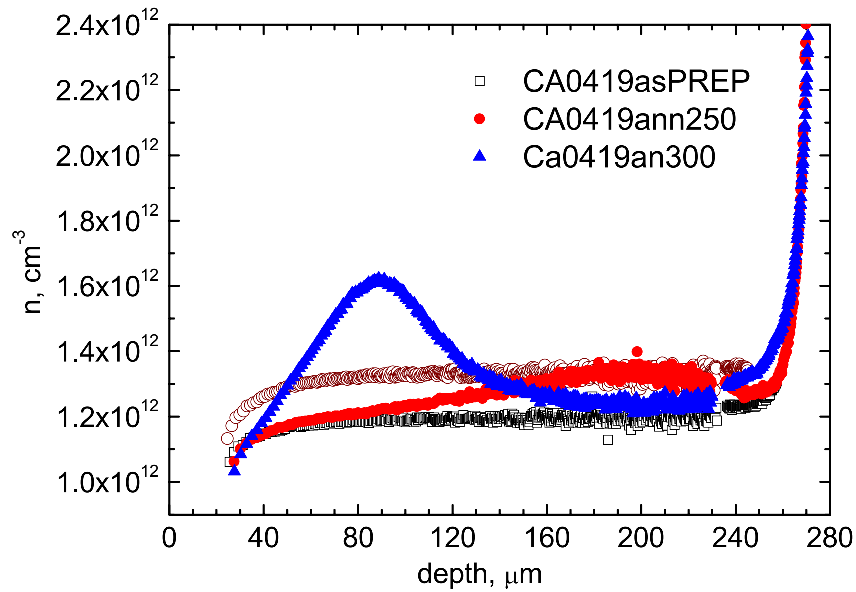


Fig. 3. DLTS spectra for hydrogenated standard FZ and oxygen doped diodes after irradiation with 3.5 MeV electrons at room temperature and upon 30-min isochronal annealing with temperature increments of 50 °C. Dose of irradiation was 3×10^{12} cm^{-2}. Measurement settings were e_n = 190 s^{-1}, bias –5 → -0 V, and pulse duration 10 ms.



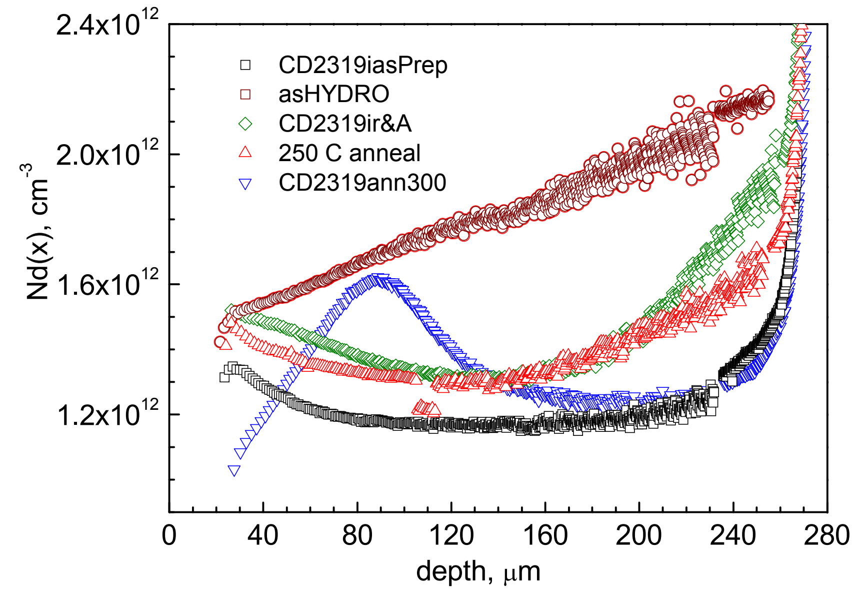


Fig 4. Annealing induced changes of the charge carrier distribution in the base region of standard (left) and oxygenated (right) FZ diodes treated in hydrogen plasma at 300 °C during 30 min .and irradiated with 3.5 MeV electrons

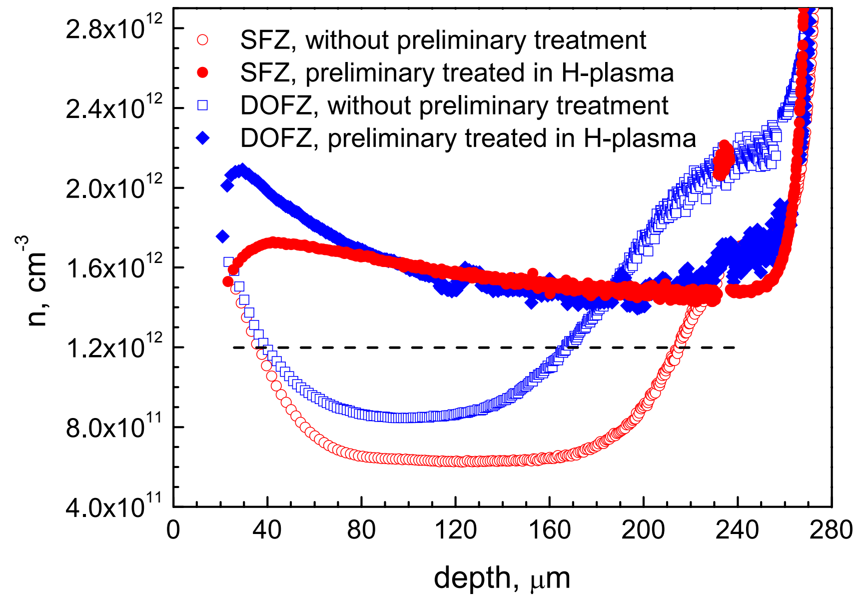


Fig 5. Comparison of charge carrier distribution in the base region of irradiated standard and oxygenated FZ diodes untreated and treated in hydrogen plasma at 300 °C during 30 min after annealing at 350 °C.

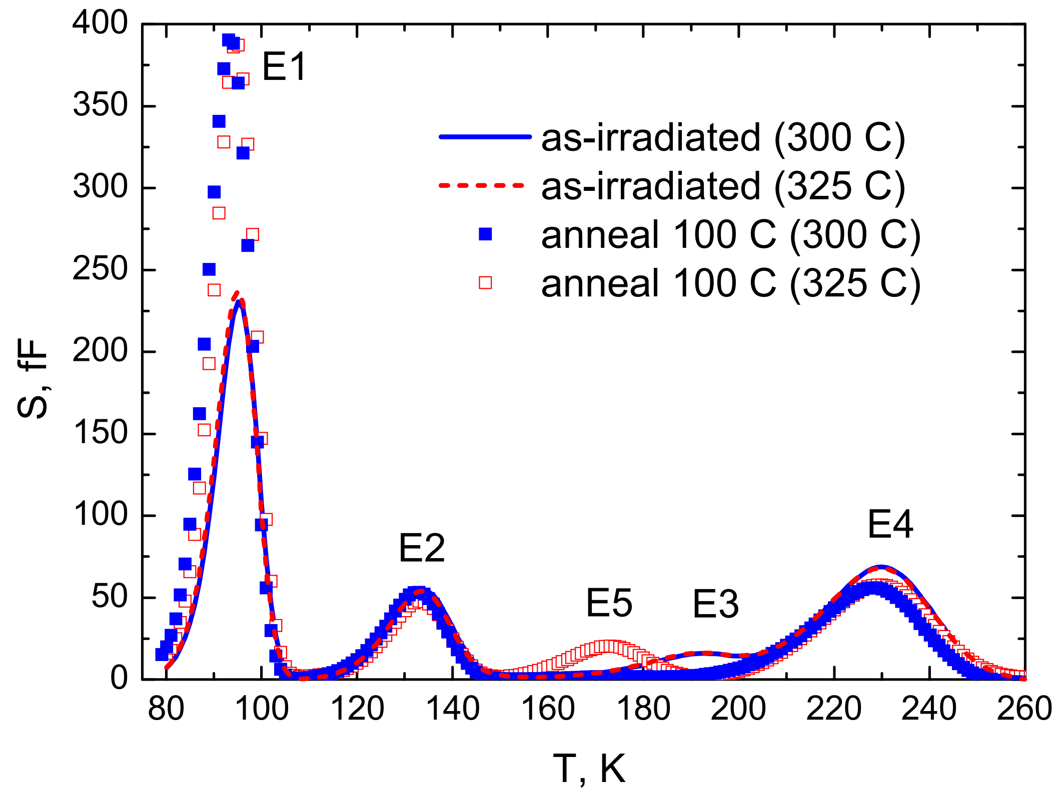


Fig. 6. DLTS spectra for standard FZ and oxygen doped diodes hydrogenated at different temperatures after irradiation with 3.5 MeV electrons at room temperature and annealed at 100 °C for 1 h. Dose of irradiation was 1×10^{12} cm^{-2}. Measurement settings were $e_n = 190$ s^{-1}, bias –5 → -0 V, and pulse duration 10 ms.

CONCLUSIONS

The treatment in hydrogen plasma at 300 °C results in penetration of hydrogen into silicon detector structures. The presence of hydrogen in the base region of the structures is evidenced by the formation of vacancy-oxygen-hydrogen (VOH) complex. Its formation begins at T_{ann}=150 °C and proceeds up to temperatures T_{ann} = 300°C. Oxygen does not influence essentially on VOH formation at 200-300 °C.

In detectors treated in plasma at higher temperature VOH is observed near p+-region even after annealing at 100 °C.

The essential transformation of hydrogen related donor profile after annealing at 250°C-350 °C has been observed. The presence of strongly doped regions influences the processes of redistribution of hydrogen by diffusion.