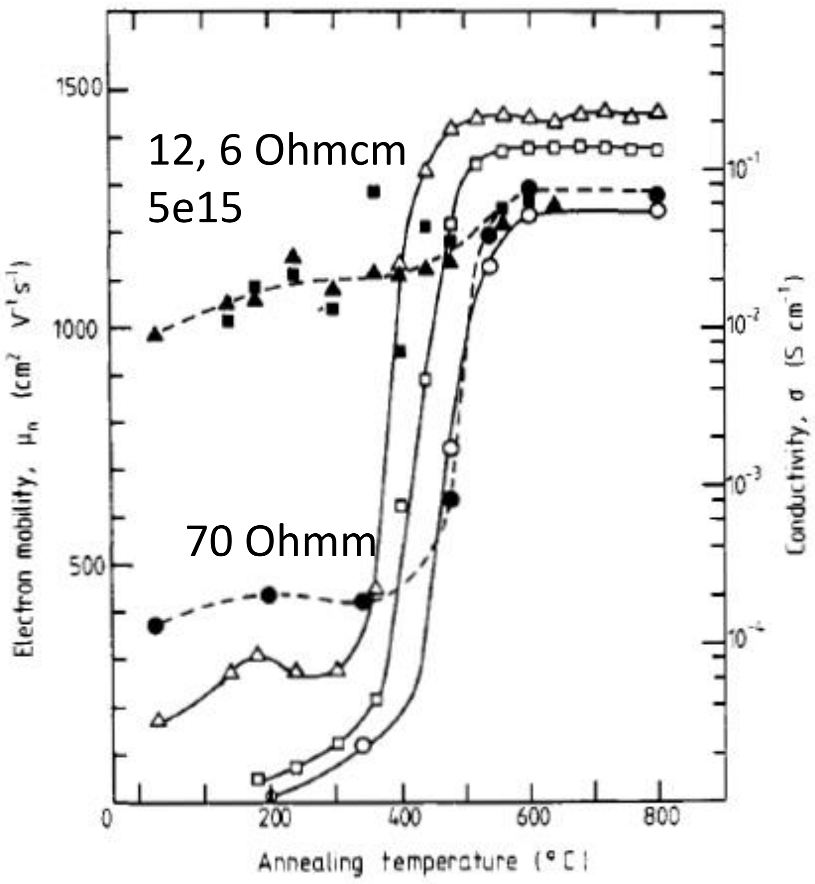
Pregled objav o vplivu obsevanja na gibljivost nosilcev

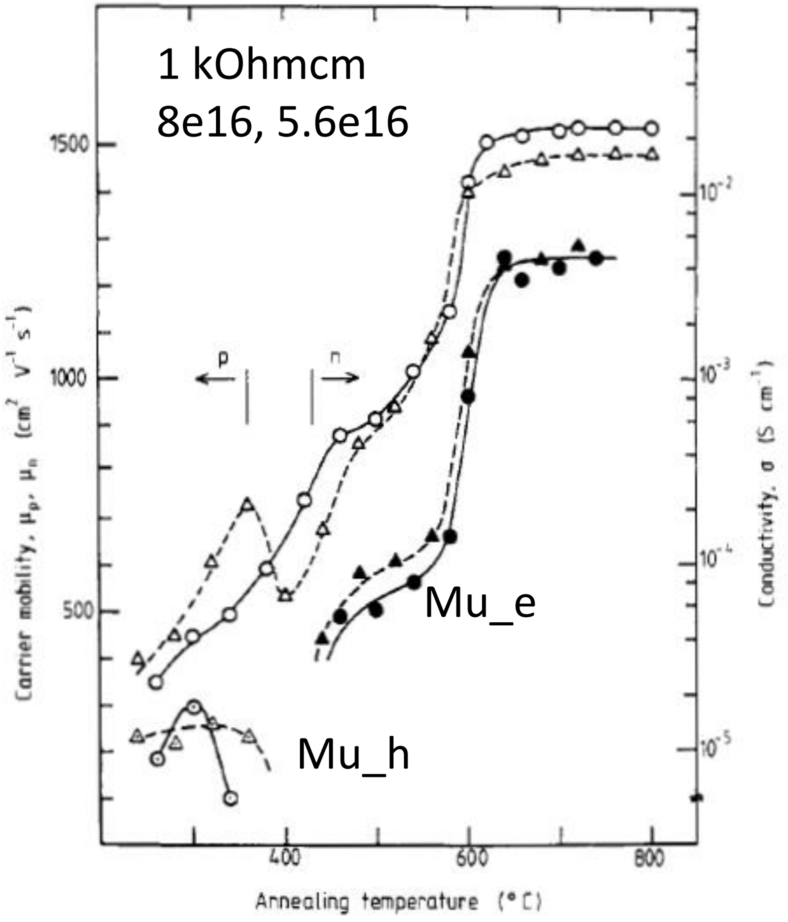
Sestanek SiC 24.4.2020

Nekaj objav iz obsevanj za neutron-transmutation. Pri tem jih je zanimalo, koliko od spremembe gibljivosti ostane po annealingu. Ni čisto jasno, kako so obsevali … ampak vidi se očitna sprememba po obsevanju.
Meritve s Hall efektom.

T Maekawa, S Inoue, M Aiura and A Usami, The effect of radiation damage on carrier mobility in neutron-transmutation-doped silicon Semicond. Sci. Technol. 3 (1988) 77-83.

Polni markerji mobility





HERMAN J. STEIN, Electrical Studies of Neutron-Irradiated n-Type Si: Defect Structure and Annealing, Phys. Rev. Vol 163, No. 3, 1967

Meritve (Hall),
spremembe opazne tudi pri nizkih fluencah.

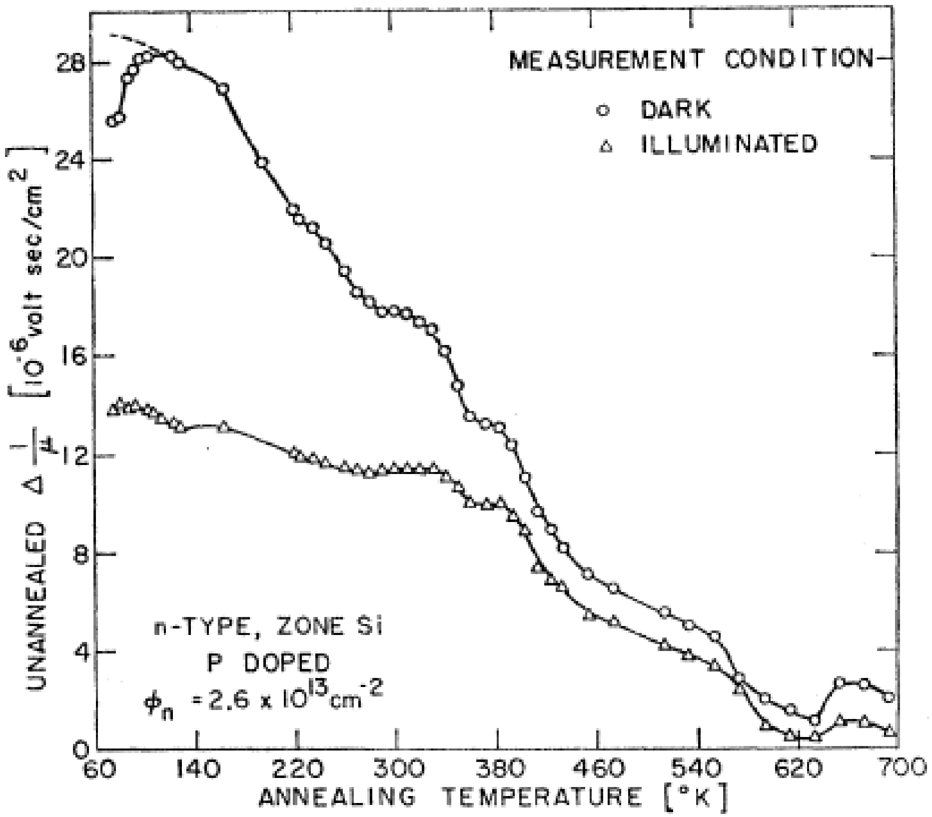


FIG. 8. Unannealed reciprocal mobility increase for float-zone silicon measured in the dark and under weak illumination at 76°K and plotted as a function of annealing temperature.

TCT meritve:

1) T.J. Brodbeck, A. Chilingarov, T. Sloan, E. Fretwurst, M. Kuhnke, G. Lindstroem (RD48)
   Carrier mobilities in irradiated silicon, NIMA 477 (2002) 287–292

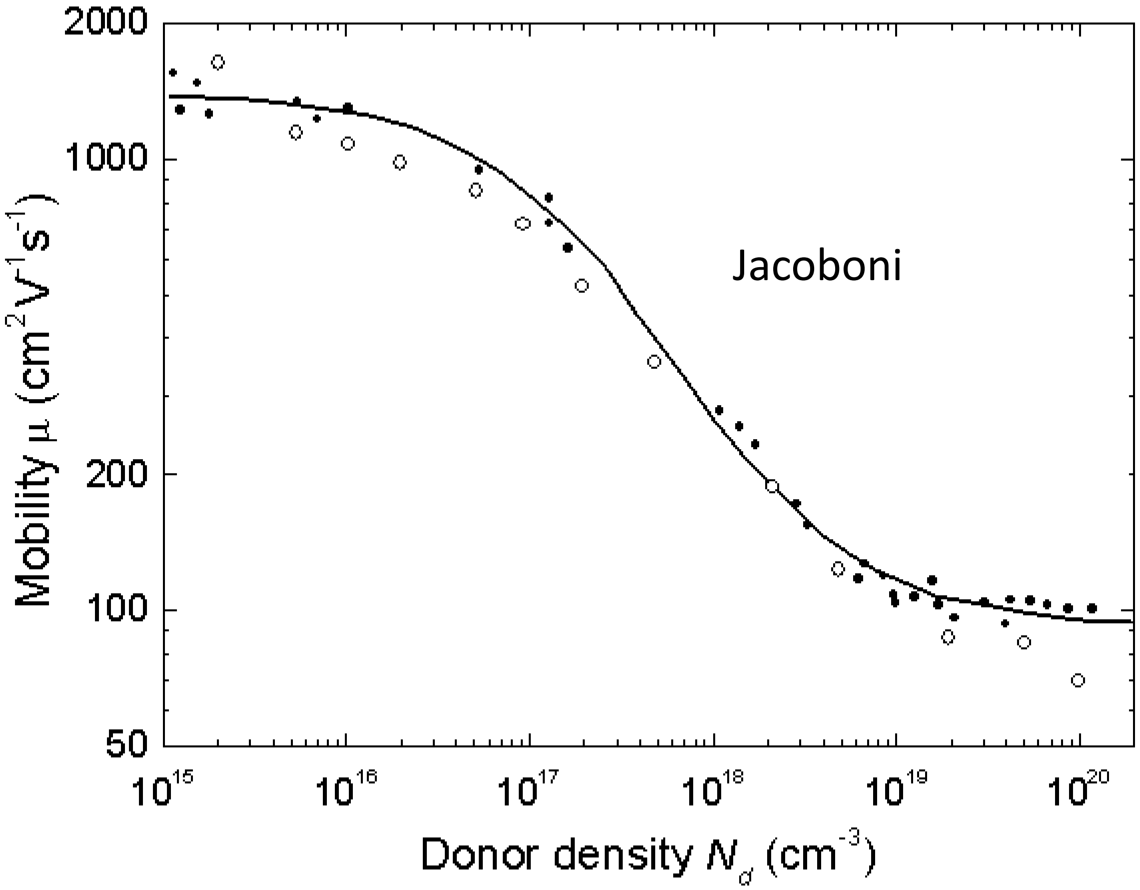
   - TCT meritve do 2.4e14 n/cm2 .. Ni sprememb gibljivosti (znotraj 10% natančnosti)

2) V. Eremin and Z. Li, Carrier drift mobility study in neutron irradiated high purity silicon, NIM A 362, 338 (1995),
   http://dx.doi.org/ 10.1016/0168-9002(95)00381-9

   - TCT, do 5e13, ni opaznih sprememb

Veliko je člankov o vplivu sipanja na ioniziranih dopantih na gibljivost

- Electron drift mobility versus donor density, T=300 K. (Jacoboni et al. [1977]).
- Proceedings of the IEEE. 55 (12): 2192–2193. doi:10.1109/PROC.1967.6123.



Odvisnost od koncentracije *N* parametrizirajo s (za N okrog 1e17):

$$\mu \sim \frac{\mu_0}{1 + \left(\frac{N}{N_{ref}}\right)^{\alpha}}$$

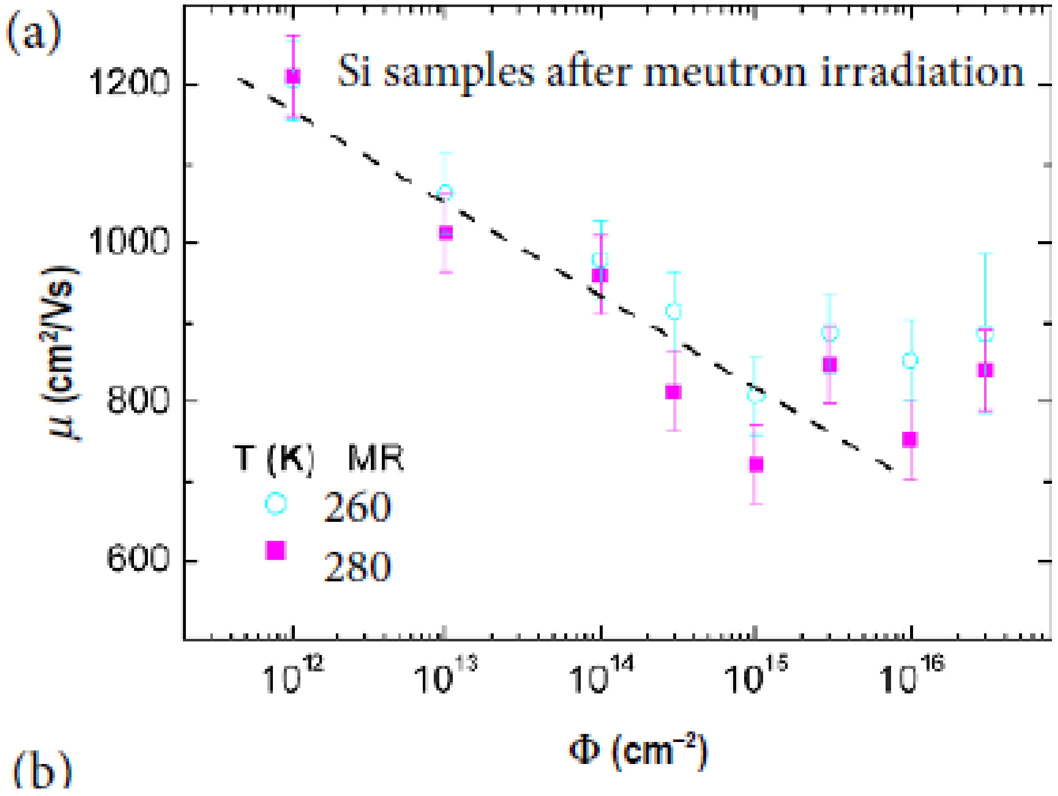
N_{ref} ~ 1E17 cm-3

a ~ 0.9

Novejše meritve

- J Vaitkus et al., NEUTRON IRRADIATION INFLUENCE ON MOBILITY AND COMPENSATION OF DARK CONDUCTIVITY IN SILICON, Lithuanian Journal of Physics, Vol. 56, No. 2, pp. 102–110 (2016)

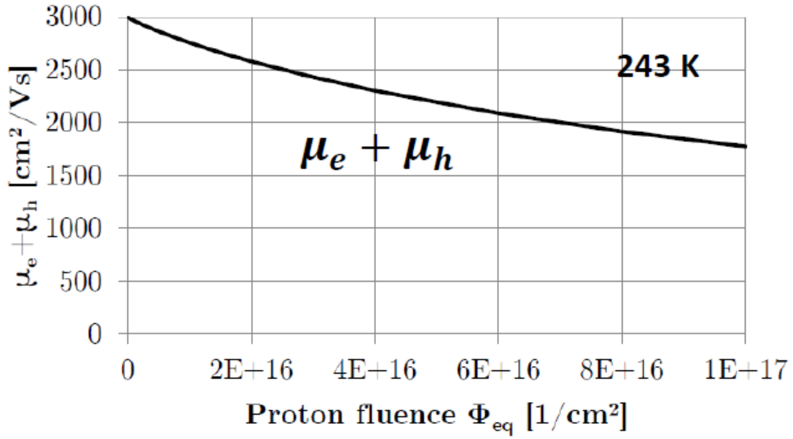
  Hall mobility:



Meri Hallov efekt, ampak ni dobro napisano kako meri…

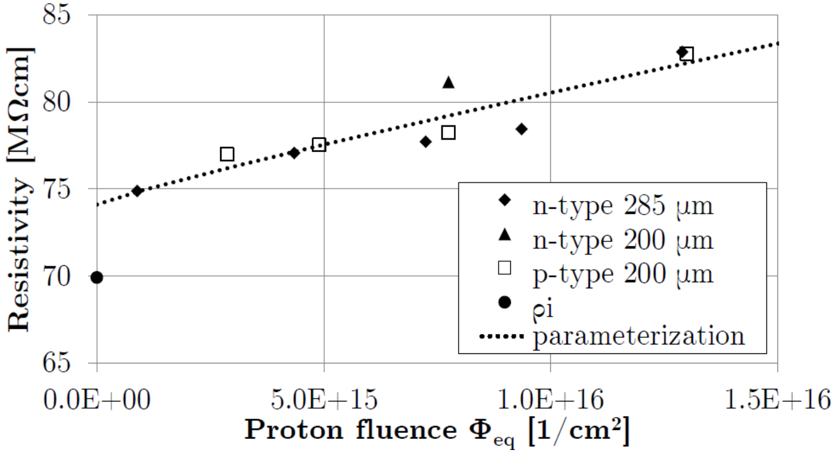
C. Scharf, PhD 2018 (predstavljeno tudi na RD50 Hamburg, 2018)

- Izmeri vsoto gibljivost iz meritev toka pri nizkih npetostih. Odvisnost od fluence (Beta_mob = 1.5e17 cm-2)
- Če vzame običajni scaling s koncetnracijo ioniziranih nečistoč (N_{reff} = 0.5-2.4 e17 cm-3) dobi iz svojega fita, da je g_eff za nabite defekte 1 cm-1
- S tem dobi dosti manjši padec gibljivosti kot ga da E-TCT
- Naše številke bi dobili, če bi bil g_eff ~ 10



200 µm & 285 µm diodes

$$\rho = \left(e n_i(\mu_e + \mu_h)\right)^{-1}$$



$$\rho_{ohm}(\Phi_{eq}) = 74.1\,\mathrm{M\Omega cm} \cdot \left(1 + \left(\frac{\Phi_{eq}}{\beta_{mob}}\right)^{0.9}\right)$$

- Assume ionized impurity scattering dominates at 243 K

$$\mu(N) = \mu_{min} + \frac{\mu_{max} - \mu_{min}}{1 + \left(\frac{N}{N_{ref}}\right)^{\varsigma}} \qquad N_{ref} \approx (0.5 - 2.4) \cdot 10^{17}\,\mathrm{cm}^{-3}$$

Neglect μ_{min} → $\mu_0^e(\Phi_{eq}) + \mu_0^h(\Phi_{eq}) \approx \frac{\mu_0^e + \mu_0^h}{1 + \left(\frac{\Phi_{eq}}{\beta_{mob}}\right)^{\varsigma}}$

$$\beta_{mob} = 1.52 \cdot 10^{17}\,\mathrm{cm}^{-2}$$
$$\beta_{mob} = N_{ref}/g_{eff}$$
$$g_{eff} \approx 1\,\mathrm{cm}^{-1}$$