Radiation hardness of n-Si irradiated by fast-pile neutrons

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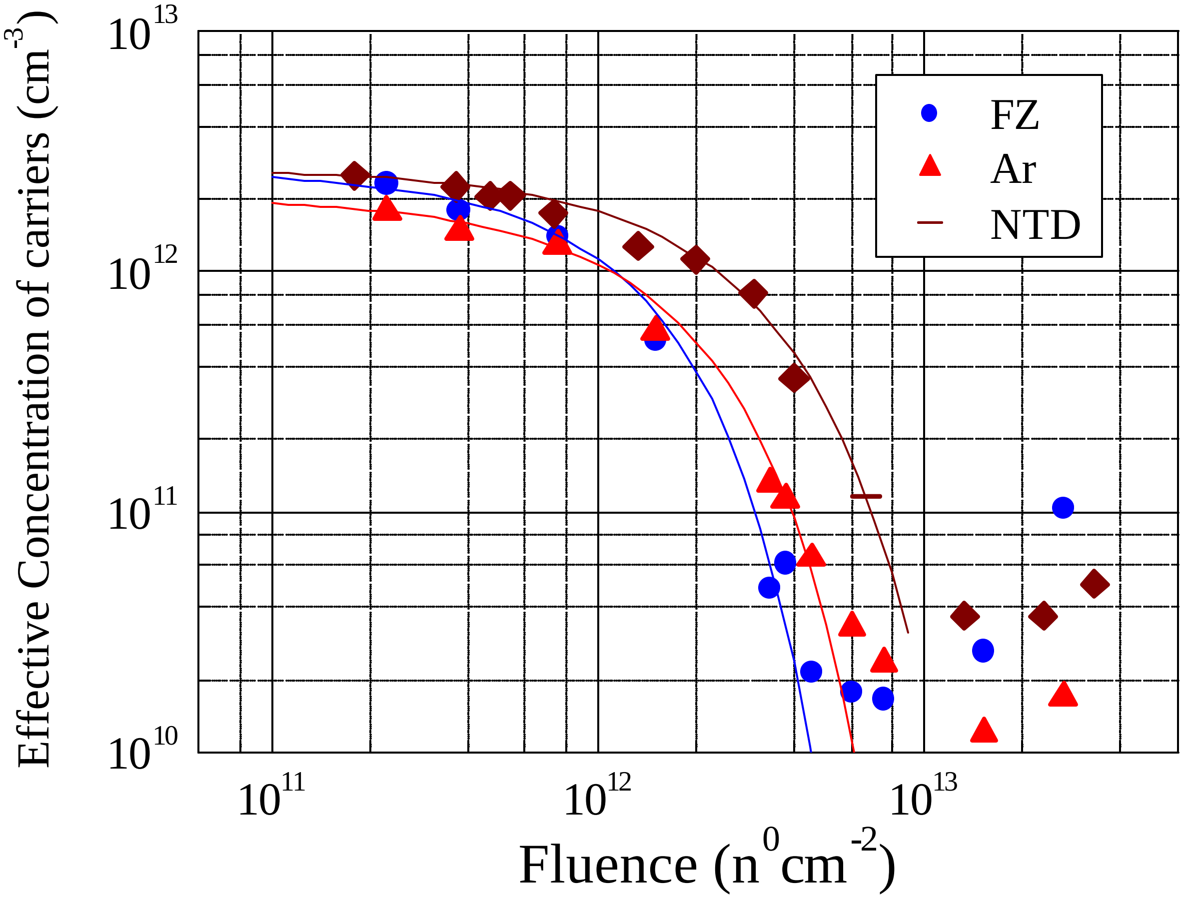

Fig. 1. The dependence of effective concentration of electrons at room temperature on the fluence of fast-pile neutrons in • – n-Si(FZ), ? – n-Si(Ar), ♦ – n-Si(NTD)

The average concentration of carriers ($\bar{n}_o$) in n-Si for: (FZ)-$2.65{\cdot}10^{12}$; (Ar)-*$2.04{\cdot}10^{12}$*; (NTD)-*$2.69{\cdot}10^{12}$* cm^{-3}; (ISV) – *$1.9{\times}10^{12}$*; (SV) – *$9.5{\times}10^{11}$*; (Top) – *$2.7{\times}10^{11}$* cm^{-3}.

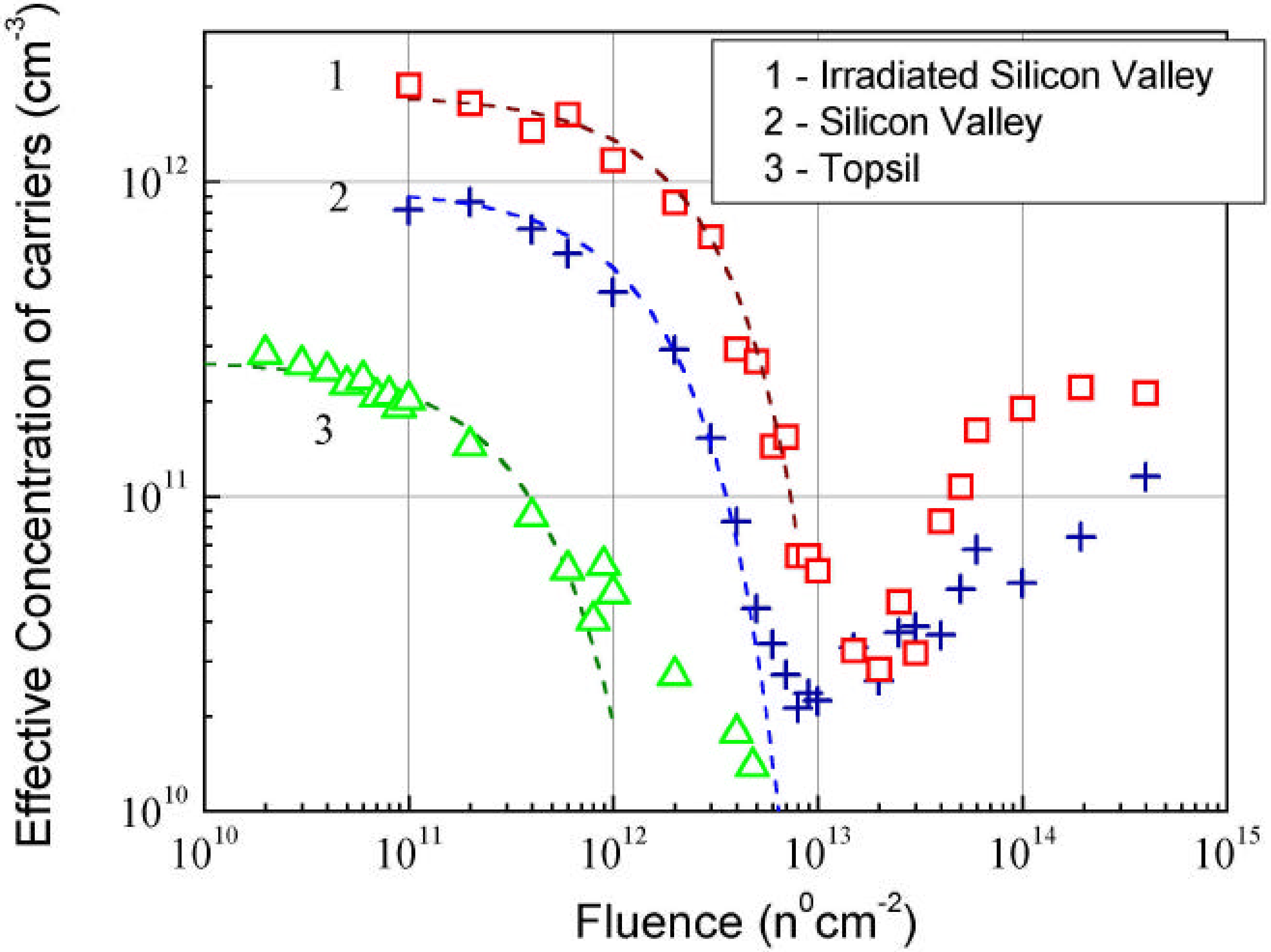

Fig. 2. The dependence of effective concentration of electrons at room temperature on the fluence of fast-pile neutrons for 1 – n-Si(ISV), 2 – n-Si(SV) 3 – n-Si(Top)

The average concentration of carriers ($\overline{n}_o$) in n-Si for: (FZ)-*2.65·10*^{12}; (Ar)-*2.04·10*^{12}; (NTD)-*2.69·10*^{12} cm^{-3}; (ISV) – *1.9×10*^{12}; (SV) – *9.5×10*^{11}; (Top) – *2.7×10*^{11} cm^{-3}.

Table 1. The introduction rates of radiation defects ν_i (E_c - 0.43 eV) and n_j (E_c - 0.315 eV) and parameters of defect clusters: R_1 and m used for description (in grown by various methods (FZ, Ar, NTD) n-Si with average concentration of carriers ($\bar{n}_o$) before the irradiation) the dependence of effective concentration of carriers on the fluence of fast-pile neutrons (2)

Si sample	***T, K***	$\bar{n}_o$, ***cm***$^{-3}$	ν_i, ***cm***$^{-1}$ ***(***E_c ***– 0.43 eV)***	n_j, ***cm***$^{-1}$ ***(***E_c ***– 0.315 eV)***	***m, eV***	R_1***, Å,***
FZ	294.4	$2.65 \cdot 10^{12}$	1.16	0.66	0.528	92
Ar	294.4	$2.04 \cdot 10^{12}$	0.46	0.66	0.523	76
NTD	298.5	$2.69 \cdot 10^{12}$	0.26	0.79	0.511	76

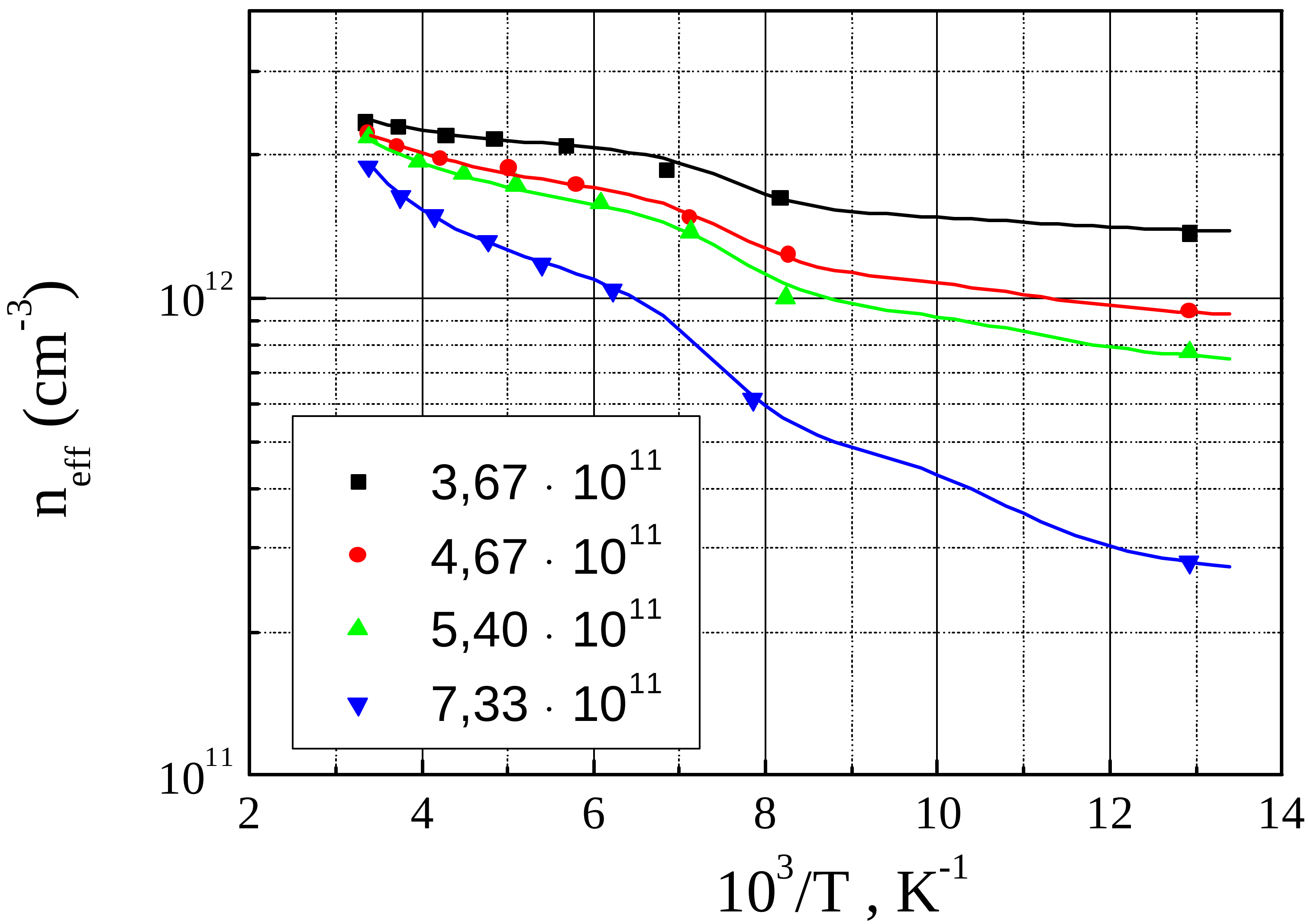

Fig. 3. The dependence of effective concentration of electrons on reciprocal temperature for n-Si (NTD) after irradiation by the fluence of fast-pile neutrons:

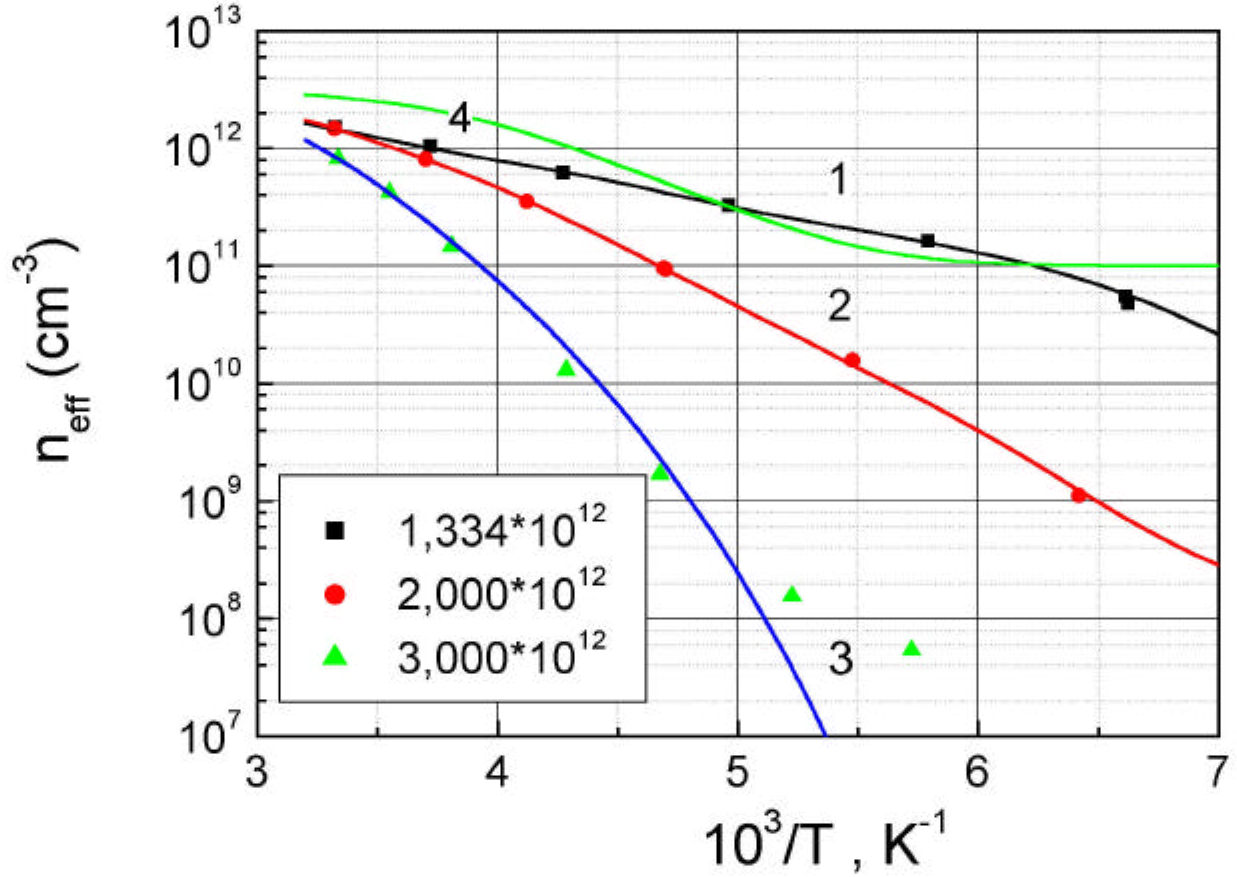

Fig. 4. The dependence of effective concentration of electrons on reciprocal temperature for n-Si (NTD) after irradiation by the fluence of fast-pile neutrons:

1 — *$1.33 \cdot 10^{12}$*; **2** — *$2.0 \cdot 10^{12}$*; **3** — *$3.0 \cdot 10^{12}$* $n^o \cdot cm^{-2}$; **4** — the concentration of electrons in the n-Si conducting matrix with the fluence *$2 \cdot 10^{12}$* $n^o \cdot cm^{-2}$

Table 2. Calculated concentration (N_a) and energy of levels (E_a) for radiation defects in the conducting matrix n-Si (NTD) irradiated by various doses of fast-pile neutrons (F); N_b is a concentration of screening centers outside the damage region of defect clusters with an average radius $\boldsymbol{R_1}$

F ($n^o \cdot cm^{-2}$)	**n_o (cm^{-3})**	**N_b (cm^{-3})**	**N_a (cm^{-3})**	**E_c-E_a (eV)**	**R_1(Å)**
$3.67 \cdot 10^{11}$	$2.67 \cdot 10^{12}$	$2.52 \cdot 10^{12}$	$6.0 \cdot 10^{11}$	0.18	36
$4.67 \cdot 10^{11}$	$2.68 \cdot 10^{12}$	$2.52 \cdot 10^{12}$	$7.0 \cdot 10^{11}$	0.18	57
$5.4 \cdot 10^{11}$	$2.64 \cdot 10^{12}$	$2.51 \cdot 10^{12}$	$7.95 \cdot 10^{11}$	0.18	58
$7.33 \cdot 10^{11}$	$2.51 \cdot 10^{12}$	$2.33 \cdot 10^{12}$	$1.08 \cdot 10^{12}$	0.19	64
$1.33 \cdot 10^{12}$	$2.35 \cdot 10^{12}$	$2.05 \cdot 10^{12}$	$1.0 \cdot 10^{12}$	0.315	60
		$1.05 \cdot 10^{12}$	$3.0 \cdot 10^{11}$	0.261	
		$7.5 \cdot 10^{11}$	$1.9 \cdot 10^{12}$	0.204	
$2.0 \cdot 10^{12}$	$3.07 \cdot 10^{12}$	$2.57 \cdot 10^{12}$	$2.47 \cdot 10^{12}$	0.36	76
$3.0 \cdot 10^{12}$	$3.07 \cdot 10^{12}$	$2.32 \cdot 10^{12}$	$1.8 \cdot 10^{12}$	0.405	86
		$5.2 \cdot 10^{11}$	$0.9 \cdot 10^{12}$	0.39	
$4.0 \cdot 10^{12}$	$2.38 \cdot 10^{12}$	$1.48 \cdot 10^{12}$	$1.2 \cdot 10^{12}$	0.39	92
$6.67 \cdot 10^{12}$	$2.51 \cdot 10^{12}$	$2.44 \cdot 10^{12}$	$1.75 \cdot 10^{12}$	0.43	92
$1.33 \cdot 10^{13}$	$2.79 \cdot 10^{12}$	$2.79 \cdot 10^{12}$	$2.78 \cdot 10^{12}$	0.62	-