COLOR CENTER CREATION IN LIF CRYSTALS UNDER 36KR ION IRRADIATION

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Color centers in LiF crystals were produced by irradiation ^{36}Kr ions on DC-60 cyclotron (Astana)

Color center creation in LiF crystals under irradiation with various ions was analyzed by K. Schwartz et al.[1]. The principal conclusion of the study was: information of processes in single ion tracks can be obtained only at fluences where ion tracks does not overlap. At high fluences where neighbor tracks overlap the irradiation takes place on a previous irradiated area of the crystals. This limited the information of single ion tracks. At high fluence Φ (or absorbed dose E_{abs}, eV/cm^2) the radiation effects mainly depend on the dose and the energy loss dE/dx play a secondary role. At low fluence the influence of the energy loss leads to a dependence on the absorbed dose (or fluence) necessary to reach a definite radiation effect, e.g. decrease of energy creation. (Table 1).

Table1. Color center in LiF crystals irradiated with 1.4 MeV ^{36}Kr ions (R = 0, 86 μm; <dE/dx> = 799 eV/nm)

Fluence, Ions/cm^2	E_{abs}, eV/cm^2	D_F	D_{F2}	n_F (n_F^s)	n_{F2} (n_{F2}^s)	D_{F2}/D_F (n_{F2}/n_F)	ΔE_F (ΔE_{F2})
$1,92\cdot10^{11}$	$2,69\cdot10^{17}$	0,55	0,131	$5,21\cdot10^{15}$ (19368)	$5,79\cdot10^{14}$ (3015)	0,238 (0,11)	51,6 (465)
$3,85\cdot10^{11}$	5,39x10^{17}	0.811	0.136	8,66x10^{15} (22500)	6,01x10^{14} (1560)	0.168 (0,069)	62,2 (897)
$5,53\cdot10^{11}$	7,74x10^{17}	1,188	0,325	$1,13\cdot10^{16}$ (20000)	1.44x10^{15} (133)	0,274 (0.13)	68,5 (538)

$8,18 \cdot 10^{11}$	$1,24 \cdot 10^{18}$	1,631	1,43	$1,55 \cdot 10^{16}$ (18949)	$6,32 \cdot 10^{15}$ (8105)	0,877 (0,408)	80 (196)
$1,2 \cdot 10^{12}$	$1,68 \cdot 10^{18}$	1,72	0,56	$1,63 \cdot 10^{16}$ (13583)	$2,48 \cdot 10^{15}$ (2067)	0,326 (0,152)	103 (677)

Explanation for table: the absorbed energy $E_{abs} = E_{ion} x\Phi$ [eV/cm^2]; n_F[cm^{-2}] = $9.48x10^{15}xD_{opt}$; n_{F2}[cm^{-2}] = $4.42x10^{15}xD_{opt}$; $n_F^s = n_F/\Phi$; n_{F2}^s[cm^{-2}] = n_{F2}/Φ. Note, that concentration of F and F_2 centers n_F^s and n_{F2}^s characterize the average number of F and F_2 centers in single tracks only in the linear part of the dependence of n_F^s and n_{F2}^s via fluence; in the saturation region of F centers the difference $\Delta n_F / \Delta\Phi$ must be used, where $\Delta n_F = n_F(\Phi_{i+1}) - n_F(\Phi_i)$ and $\Delta\Phi = \Phi_{i+1} - \Phi_i$: The same must done for n_{F2}. We used the parameters n_F^s and n_{F2}^s only for estimation of ΔE_F and ΔE_{F2} – the energy to create an F or F_2 center - parameters characterizing the efficiency of F and F_2 center creation. Note, that at the absorbed energy of (0,269 – 1,68)x10^{18} eV/cm^2 only F and F_2 centers are produced. The F_3 , F_4, etc. are produced only at higher fluences where neighbor tracks overlap.

1. K. Schwartz et.al. Phys. Rev. B 70 (2004) 184104-1-8.