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Total length of the accelerated iron ions range-increasing effect in quartz glass, comprised the tracks

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Introduction

Radiation effects from the cosmic ray irradiation in the silicate microcrystals is one of the major factor of their chemical and phase composition modification. Due to charge, mass and energy of the cosmic ray nuclei and the total dose of irradiation in the exposed silicates different radiation effects can be influenced [*Kashkarov*, 1996]. Modelling of these process with help of the accelerated low-energy ions H, D, He and Ar [S*hilobreeva and Kusmin*, 2003; *Shilobreeva and Kusmin*, 2004] indicate, that chemical composition of the interplanetary matter could be essentially changed. For these reasons experimental investigations of the volume distribution inside of individual silicate microcrystals undervented to different exposure of the cosmic rays, was investigated in the works [*Shilobreeva et al.*., 2006; *Shilobreeva et al.*, 2007]. Experimental investigation of the individual silicate micrograins of the lunar regolith matter, determined by using of the fossil track method, were performed in the works [*Kashkarov et al.,* 2006; 2007; 2010], that generate a need of the carrying out of further inquiry of these processes. In the present work the preliminary results on theoretical estimation of the radiation-induced supposed effect of the gain in the trace length of accelerated (energy E = 85 keV) iron ions in the quartz glass, which was preliminary irradiated by the same ions, are considered .

Mechanism of the gain in the ions trace length in solid dielectric matter

An assumption on the possible mechanism of the gain in the ion trace length value in dielectric solid state matter, specifically in the quartz, is based on the next positions:

(a) Along of the path of the braking ion in the solid dielectric matter the cylindrical zone of the structure disordering is formed. The diameter of these zones are of (10-30) Å.

(b) After of the first-step ion irradiation dose the corresponding inter-volume density of the nano-structure disordering is formed.

(c) At prescribed value of these nano-structure disordering zones passing of the ions of the next step of irradiation any parts of their total path-length coincide with these zones. It can be bring to a smaller energy loss, principally concerned with the nuclear interaction.

As the main result of this mechanism, the total path-long of the movable ions can be enlarged.

On the microphotographs of Figure 1 the samples of the chemically etched tracks, formed by the iron nuclei of the solar cosmic ray in the lunar soil olivine micro crystals are presented.

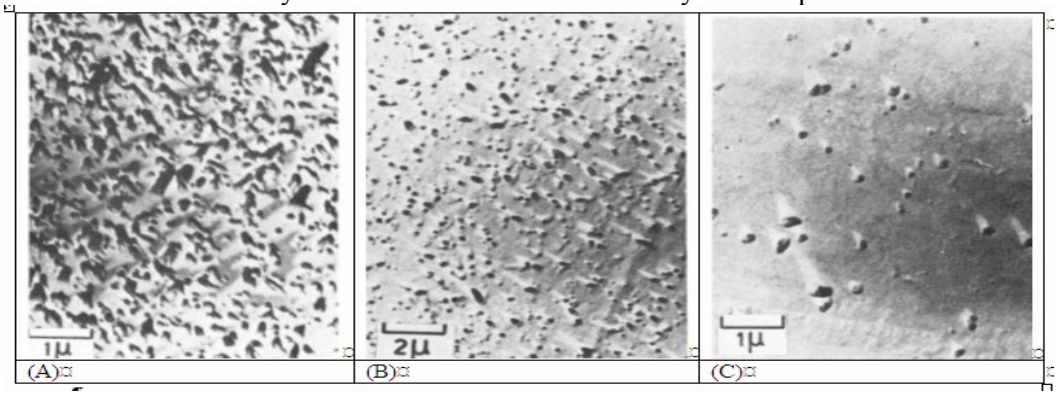

Fig. 1. The microphotographs of the chemically etched tracks, formed by the iron nuclei of the solar cosmic ray in the lunar soil olivine micro crystals extracted from the ALS “Luna 16” column. The track-densities (in track per cm^2): (A) ~ 10^9; (B) ~ $3 \cdot 10^8$; (C) ~ $5 \cdot 10^7$.

It is obviously that the value of the assumed effect of the ion path-length prolongation will be direct variation to the volume track-density, formed during of the first step of the ion irradiation. Graphical display of the some these intersection cases are shown in the Fig. 2.

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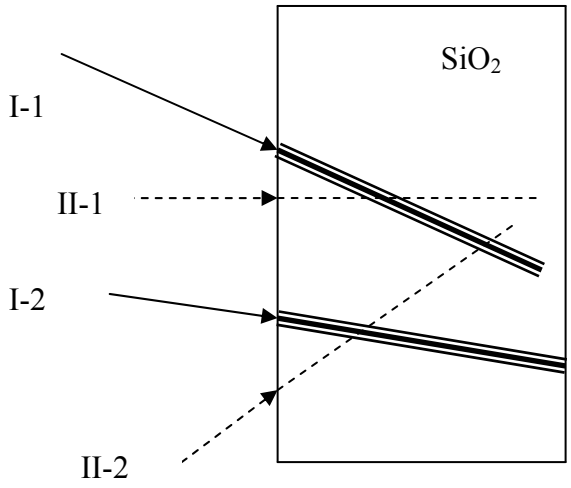

Fig. 2. Graphical display of the two chaotic oriented traces of the first-step braked ions (I-1, I-2) and the cases of their transactions be the ions of the second-step irradiation (II-1, II-2).

The results of the quantitative effect estimation

In the frame of the proposed model the preliminary quantitative effect estimation in the case of the first-step iron ions irradiation dose equal to $(1\text{-}10)\cdot 10^{13}$ ion·cm^{-2} the middle path-length for the ions of the second-step irradiation can be increased up (5-10)%.

Conclusions

On the base of the preliminary obtained results of the theory estimation we can constitute on the quantity level, that observed in some lunar regolith olivine grains weakly-sloping from edg to edge of single crystals changes in Mg, Fe, Ca and Si concentration can be due to comparatively high the total dose values of the solar cosmic ray irradiation.

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