MODELLING OF THE CHONDRULE FORMATION PROCESS BY LASER RADIATION. L.L.Kashkarov, A.V.Fisenko. Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow, USSR.

One of the major conclusion from a numerous researchs of the chondrule formation processes as a liquid submillimeter size spherical objects is their origin in a high-temperature short-time cases going in the gas-dust precompaction cloud conditions /1,2/. The aim of a model experiments (for example /3/) was established of the physical-chemical conditions at which the distinct types of chondrules can be formed: from wholly glass spherules to the most abundant the porphyritic olivine and olivine-pyroxene chondrules with granular and microporphyritic textures. At that time the number of conclusions being from investigation of the ordinary chondrite radiation history /4/ were not completely explained, because there was not accordance between parameters of pre-accretion exposure and presence of the melted silicate phases in the chondrule formation processes. As one of the possibility for the individual microporphyritic chondrules it was accepted the agglomeration process of formation without total melting of the initial matter, that was hardly explained from the petrology point of view.

We have attempted experiments on formation of chondrule-like objects on purpose to test the track stability degree in the olivine crystals undergoing essential high-temperature short-time influence. It was performed two series of experiments on the impulse laser-light exposure of the investigated matter. The used laser parameters: \( \lambda = 1.06 \, \mu \text{m} \), the light beam diameter \( \sim 30 \, \mu \text{m} \), vacuum \( < 5 \times 10^{-4} \, \text{mm} \) of Hg. In the first series the polished and irradiated by the fission fragments of \( ^{252} \text{Cf} \) source olivine crystal surface was exposed by the laser beam. In the attack points was observed a melted phases on a board of which were seen the transient zones with the track-density gradients. Precise counting of these tracks indicate their full stability at the distance about \( 10 \, \mu \text{m} \) from the melted phase.

The second series included the exposure of the mixture consisted from two major components (in relation 10:1): the olivine crystals from the Marjalahti pallasite (grain size interval from \( \sim 10 \) to \( 200 \, \mu \text{m} \)) and the fine-grained (size about \( 1 \, \mu \text{m} \)) matrix material from the Melnokha L5 chondrite. Average track-density value in olivine crystals equal to about \( 10^6 \, \text{cm}^{-2} \) and due to the galactic cosmic ray \( \text{V\lowercase{I}}-\text{nucl\lowercase{i}}. \) After laser influence the partly or commonly melted objects, consisted from agglomerates of olivine crystals in melted glass phases, were mounted in epoxy resin, polished and etched for the revealing of tracks. The particular information was obtained for the solidified melt droplets (see Figure 1), textures of which are analogue to barred olivine and porphyritic olivine chondrules. The
most interesting result is the fact of the track storage in the individual olivine crystals incorporated inside of these melted spherules. Apparently the process of the fine-grained matter melting and cooling in these cases was going so quickly, that the olivine grains of size smaller than about 50 µm (Fig. 1a) and 20 µm (Fig. 1b) not only were not melted but also these crystals partly or commonly stored VH-tracks. On these results it stands to reason the real possibility of the VH-tracks stability in the silicate crystals that are the pre-existing components of the melt droplets natural chondrules. This conclusion have of far reaching importance for the interpretation of the many events when VH-tracks are observed in pre-irradiated crystals included then inside of a melt droplets.


Figure 1. Samples of the chondrule-like melt droplets with barred olivine, porphyritic and microgranular textures.