HAXONITE IN CHELYABINSK LL5 METEORITE

V. I. Grokhovsky, E. V. Brusnitsyna and G. A. Yakovlev. Institute of Physics and Technology, Ural Federal University, Ekaterinburg, 620002, Russian Federation. E-mail: grokh47@mail.ru.

Introduction: The Chelyabinsk LL5 meteorite fell on February 15, 2013 with numerous fragments formation. Their macroscopical analysis demonstrated that these fragments have different lithology: slightly shocked light-colored lithology and melted black-colored lithology with two visible zones [1]. We investigated metal structure in fragment of the Chelyabinsk meteorite with light lithology. For the first time haxonite $(Fe, Ni, Co)_{23}C_6$ was found in Chelyabinsk LL5 meteorite.

Experimental: Light-colored fragment of Chelyabinsk LL5 meteorite 4,34 g in weight was chosen for examination. Fragment section 1x2,5 cm was prepared for the optical and scanning electron microscopy investigation using standard metallographic procedure. After 2% Nital etching the microstructure of the meteoritic metal was examined by inverted microscope Axiovert 40 MAT and FE-SEM SIGMA VP with EDS and EBSD units.

Results and Discussion: Most metallic grains in the light fragment of Chelyabinsk meteorite contain zoned taenite. We investigated the largest zoned taenite particle of the size of 350 μm in width and 1000 μm in long. Kamacite and troilite are associated with this taenite particle. Along the edges of the particles cloudy taenite is observed. Cloudy zone is a result of spinodal decomposition at low temperatures in the revision diagram Fe-Ni [2]. Size of high-Ni particles next to the boundary with the tetrataenite rim was measured where the local Ni concentration is 40–42 wt.% Ni using the procedure developed [3,4]. The mean size of the high-Ni particles in cloudy zone for the Chelyabinsk meteorite is 146 nm. The value was compared with cooling rate curves for ordinary chondrites [3, 4]. In this case the cooling rate for Chelyabinsk meteorite is about 5°C/Myr. Also in the center of taenite particle we observe martensite.

Haxonite was found in taenite area of the metal grain near boundary taenite/kamacite. Taenite grain contain haxonite up to several μm across, which are laden with micrometer-sized high-Ni particles (light particles in dark matrix). EBSD analysis confirmed that light particles have taenite lattice and dark matrix have haxonite lattice. Earlier the cubic carbide in iron meteorites has been well described by Scott [5]. Furthermore haxonite was observed in unequilibrated ordinary chondrites of type 3 [6].

Previously[7] it is suggested, that after crystallization was complete, graphite and carbides precipitated. Carbides formed at low temperature after kamacite and schreibersite. In our section graphite was not found.

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