THE INFLUENCE OF INCLUSIONS ON THE FORMATION OF METAL STRUCTURE IN ATAXITES

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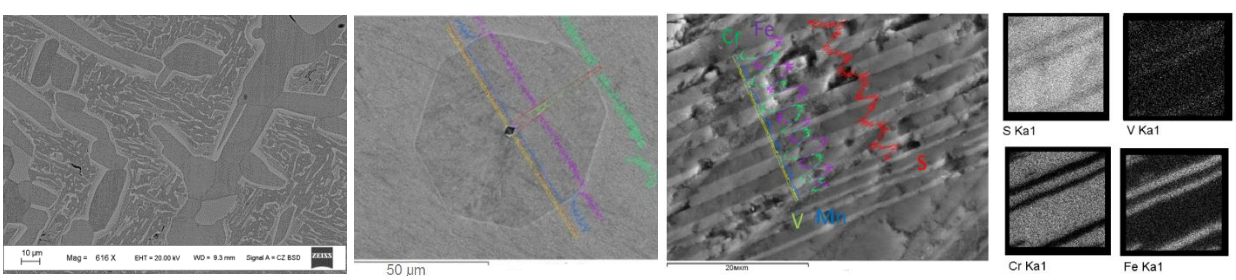
Introduction: Plessite microstructure is formed from taenite: γ (fcc) → α_2(bcc)+γ(fcc) → α(bcc)+γ(fcc) at different temperature and Ni concentration in accordance with Fe-Ni phase diagram [1]. There are four morphological types of martensitic structure: lath (packet); butterfly; lenticular and thin plate martensite[2]. It is observed in Fe-Ni artificial and meteorite alloys. Nearby nonmetallic inclusions in high-Ni meteorites (15-20 wt.% Ni) is in focus of our interest. Chemical composition revealed that the metal surrounding FeS-$FeCr_2S_4$ inclusions contain higher Ni concentration and small inclusions of $(FeNi)_3P$ that altogether influences the temperature of bainite transformation in the region and forwards the nucleation of the oriented structure of plessite. EBSD method was applied to reveal crystallographic orientations in plessite.

Experimental: Seven meteorites were studied in the current work: Hoba (16,56 wt.% Ni, 0,07 wt.% P), Cape of Good Hope* (16,3 wt.% Ni, 0,12 wt.% P), Tawallah Valley (17,6 wt.% Ni, 0,10 wt.% P) and Iquique (16 wt.% Ni, 0,09 wt.% P) IVB members and also some close relative to the group ataxites: Chinga (16,58 wt.% Ni, 0,05 wt.% P) and Gebel Kamil (20,7 wt.% Ni, 0,16 wt.%P), El Qoseir (14,0%Ni, 0,7% Co, 0,16%P) [3]. The meteoritic metal microstructure was examined using Zeiss Axiovert 40 MAT inverted microscope and FE-SEM ∑IGMA VP electron microscope with EBSD and EDS units.

Results and Discussion: Meteorites sections demonstrated the various amount of inclusions. The sections of Hoba and Iquique meteorite demonstrated quite rare small (50x5 μm and 3x2 μm) inclusions of troilite FeS and daubréelite $(FeNi)_3P$ of comparable size with irregular shape rarely in the intergrowth but no laths. Several large (0,5-3 mm) troilite-daubréelite inclusions of rectangular and rounded shape in Hoba were surrounded by oriented plessite. Numerous inclusions of troilite FeS and Cr_2FeS_4 appear to be the nucleus for the α-spindeles (Fig. 1 a,b). Schlieren bands [3, 4] cross the whole samples of the meteorites and are not disturbed by the inclusions, even in Hoba, where plessite structure differs nearby large inclusions.

Schlieren bands in Chinga are well defined [3, 5] with rare inclusions. The authors [5] gave us a few examples of the troilite-daubréelite intergrowth in the form of laths with enrichment of V and Mn – the same we observed in Cape of Good Hope (Fig. 1 c,d). Plessite surrounding the inclusions and the embryos of the α-phase is well distinguished with an optical microscope in Hoba and Iquique meteorites, is well distinguished and grossly structural in Gebel Kamil, Tawallah Valley and El Qoseir meteorites (Fig. 1 a), poorly soluble in Chinga [4].



a b c d

Figure 1 – FeS-$FeCr_2S_4$ inclusions in the ataxites: a - SEM-images El Qoseir (14,0%Ni, 0,7% Co, 0,16%P), b - An example of the growth of the α-phase embryo around the inclusion of daubreelite in the cross section in Cape of Good Hope, c - troilite and daubreelite lamela with elements profiles: Fe, Cr ,S, Mn, V in Cape of Good Hope, d- elements distribution in the inclusion (c).

The largest α-spindeles are stretched parallel to the border of the Schlieren bands. EDS –analysis proved that about 30% of the α-phase nuclei of Gebel Kamil and Tavallah Valley and Hoba nearby the large inclusions of FeS-$FeCr_2S_4$, $(FeNi)_3P$ contain micro-inclusions of schreibersite, and also chromites and troilite [3].

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