STRUCTURE AND COMPOSITION OF SHOCK RE-MELTING LUNAR METALLIC PARTICLES.

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Introduction: Part of metal particles in delivered to the Earth lunar soil is no more than 0.5% [1]. Some of them have typical content of Co:Ni for iron meteorites and chondrites. They have spherical shape and were formed during impact melting of meteorites [2]. In this work large metal particles from Luna 20 soil samples are investigated using modern equipment.

Samples and Methods: Two metal particles (20045-544 and 2004-016) from highland region of the Moon are the objects of investigation. Particle 2004-016 have pear shape and weigh 276.4 mg. It is the largest lunar metal sample to date, over 6.3 mm in its longest dimension. Structure of samples 2004-016 and 20045-544 was study using optical microscopy and FE SEM Sigma VP with EDS and EBSD units.

Results and Discussion: Particle 20045-544 have a dendrite shape with a maximum size of 1.3 mm and have bulk composition 2.3 wt. % P, 2.06 wt. % S. Particle 2004-016 have bulk composition 3,42 wt. % P, 2,28 wt. % S. According to [3] iron meteorites usually contain lower amounts of P and S. It can be explained by different interaction between meteorites with Moon and Earth. It is known that iron meteorites are the products of planetary differentiation. Fe-Ni monocrystals formed during this process could have sizes in range from one cm to several meters [4]. P and S segregated along boundaries of these crystals during cooling as phosphides and sulfides. Cracks propagate through relatively fragile phosphides and sulphides during fragmentation in the atmosphere. These inclusions disappear during ablation. But in case of absence of atmosphere unburned phosphides and sulfides enrich content of P and S in metal particles of lunar soil.

P and S enrichment result in sulfides and phosphides diversity. In sample 20045-544 one can observe a eutectic α + ph in interdendritic space. Six morphotype of phosphides and three morphotype of sulfides can be distinguished in structure of 2004-016. Also rims with Ni content up to 12.5% have been observed around all sulfide inclusion in 2004-016.

Structure of 2004-016 sample contain crystallization features and satisfy condition of high-vacuum shock melting and Fe-Ni-Co-P-S alloy crystallization under low gravity. Cooling rate in crystallization range (approximately 0.1˚ C/s) was evaluated using cell size of kamacite. Despite occurred shrinkage phenomena, microporosity has not been observed. This means that melt which was formed after meteorite falling to the Moon did not contain dissolved gases.

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