BRITTLE FRACTURE RESISTANCE OF CHINGA ATAXITE AT DIFFERENT MECHANICAL LOADING CONDITIONS.

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Introduction: The dynamic strength of meteorites plays a significant role in asteroid hazard mitignation [1]. It was shown previously that the highest value of impact strength of 2210 kJ/m2 was obtained for Chinga ataxite [2]. In this study comparative results of Chinga meteorite material fracture resistance evaluation at different test temperatures and loading conditions using fracture mechanics approach as well as fractographic data analysis are presented.

Experimental: Samples for the mechanical tests having size of 10 x 10 x 55 mm were cut from a uniform piece of Chinga ataxite. Initiation and growth of fatigue cracks was carried out using high-frequency resonant MIKROTRON (RUMUL) machine at loading frequency of $f \approx 100$ Hz. Static tests were performed according to the scheme of 3-point bending on universal testing machine INSTRON8801 according to GOST 25.506-85. Impact tests in the temperature range 20...-196°C were carried out according to standards GOST 9454-78 and 22848-77 with the use of an instrumented impact test machine Tinius Olsen IT542 with record charts of impact loading in coordinates "load-displacement", which allowed to divide the total of specimen's fracture energy (A) into its components – energy of crack initiation (Ai) and crack propagation (Ap) as well as to determine the dynamic fracture toughness values (Jid). Fractographic observations of meteoritic material samples after mechanical tests were performed with the use of scanning electron microscopes Tescan VEGA II XMU and JEOL JSM -66490LV.

Results and Discussion: The influence of test temperature on the impact strength and dynamic fracture toughness of a Chinga meteorite with the level of strength properties at T = 20 °C corresponding to $\sigma_{0,2}$ = 825 MPa and σ_B = 855 MPa was studied. It was pointed out that lowering the test temperature from 20 to -196°C causes a decrease in KCV impact strength values in 3.15 times, while the performance of dynamic fracture toughness J_{1d} decrease was less significant - 1.3 and 1.2 times, respectively. It specifies on maintenance of ductile properties of meteorite material at cryogenic temperatures in the presence of such defects as fatigue cracks. Thus in the studied meteoritic material at the temperature of liquid nitrogen high values of static fracture toughness (K_{1C} = 91...95 MPa x $m^{1/2}$) are saved. For the first time on results of cyclic tests on the basis of 6 x 10^4 cycles the kinetic diagram of meteoritic material fatigue fracture in coordinates "dl/dN (rate of fatigue crack) – ΔK (scope of stress intensity factor at the crack tip)" was obtained. Fractographic analysis using the image processing SIAMS Photolab software found that with decreasing of temperature fracture surface becomes more heterogeneous and along side with reducing of ductile dimples volume fraction the share of brittle (quasi-cleavage) sites on fracture surface increases. The characteristic features of Chinga ataxite specimen fracture micro-mechanisms in the area of fatigue crack growth (fatigue striations relief) was revealed. The chemical composition of inclusions presented on meteoritic specimen fracture surface were determined and classified.

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References: [1] Derek W.G. Sears et al. 2016. *Planetary and Space Science* 124:105–117. [2] V.I. Grokhovsky, S.V. Gladkovsky. 2010. *Meteoritics & Planetary Science* 45:A69.