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Comparative Study of the Mechanical and Tribological Characteristics of Fe–Cu–Ni–Sn Composites with Different CrB2 Content under Dry and Wet Friction

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Abstract. The structure, phase composition, hardness, and elasticity modulus of sintered Fe–Cu–Ni–Sn–CrB2 composites and their tribological properties under dry and wet friction have been studied by X-ray diffraction, scanning electron microscopy, microindentation, and tribological testing. The obtained results have demonstrated that the microstructure and mechanical and tribological properties of these composites depend on the CrB2 additive content. The Fe–Cu–Ni–Sn–CrB2 composites incorporate the α-Fe, γ-Fe, and Cu phases and a certain fraction of the crystalline Cu9NiSn3, NiSn3, and CrB2 phases. The hardness and elasticity modulus of these composites are almost independent of the friction medium (dry or wet), and the friction force and the wear rate are variable. The Fe–Cu–Ni–Sn–CrB2 composites are superior to the Fe–Cu–Ni–Sn composites in their mechanical and tribological properties. The addition of 2 wt % of CrB2 to the 51Fe–32Cu–9Ni–8Sn composite has decreased the friction force from 220 to 170 mN and the wear rate from 7.41 × 10–2 to 3.41 × 10–2 mm3/(N m) under dry friction and, respectively, from 200 to 140 mN and from 8.19 × 10–2 to 4.10 × 10–2 mm3/(N m) under wet friction. A further growth in the CrB2 content in the composites leads to an increase in the wear rate. The mechanism of increase in the wear resistance of the composite containing 2 wt % of CrB2 as compared to the initial composite implies the formation of a more fine-grained structure with an optimal combination of the hardness and elasticity modulus. The Fe–Cu–Ni–Sn–CrB2 composites can be used as a material for the matrix of composite diamond-containing materials subjected to strong wear.

Keywords: composite, concentration, structure, hardness, elasticity modulus, tribological tests, dry and wet friction, wear resistance

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