EFFECT OF POLYPHOSPHORIC ACID AND ZINC PHOSPHATE ON THE THERMO-OXIDATIVE STABILITY OF GRAPHITE FOIL

Gracheva A.V., Gubin V.Yu., Nigmatullin I.K.,
Morozov N.S., Klyukova K.E., Khachatryan E.G.
Moscow State University
119991, Moscow, Leninskie Gory, 1

Graphite foil (GF) is a unique material with high chemical resistance to most aggressive substances uses as a gasket materials or heat spreader. Thus, it is widely used in the oil and gas, energy, aerospace, instrumentation manufacturing and other industries. A pure GFs have high oxidation rate in air at elevated temperatures, carbon losses being up to 15-20 mass%/h at 670°C. Different methods of GF modification are used to reduce oxygen influence and extend service life of graphite material. The aim of the work is to identify the composition of the additives and methods of their addition to the development of a modified material with high temperature resistance based on the natural flake graphite (NG).

GF is obtained by pressure treatment of thermally expanded graphite (TEG) produced by reduction-oxidation with fuming nitric acid and heat treatment of NG. Phosphorous insertion in the graphite matrix structure results in oxidation decrease. Modifying agents are considered to be phosphorus compounds: polyphosphoric acid (PPA) $H_{n+2}P_nO_{3n+1}$ (~115% H_3PO_4 basis) and monosubstituted zinc phosphate $Zn(H_2PO_4)_2{\cdot}2H_20$ (ZP). PPA was added into the oxidation solution with different concentration. PPA content increase was shown to reduce GF oxidation noticeably (0% - 15±2 mass%/h, 10 % - 2,3±0,2 mass%/h, 40% - 1,0±0,3 mass%/h).

Carbon loss reduction method with ZP-based precursor during NG hydrolysis oxidized with 5% PPA was also investigated. Oxidation was 3,0±0,2 mass%/h without the ZP and – 1,9±0,1 mass%/h with it. Energy-dispersive X-ray spectroscopy paired with SEM was used to examine residual phosphorous and zinc contents in GF samples (without ZP additive: P = 600 ppm; with it: P = 1800 ppm, Zn = 5000 ppm). Since oxidized graphite undergoes heat treatment it is obviously that these elements are impregnated into the graphite, where they help passivate active sites and lattice defects formed during heat treatment.