Friction and wear characterization of Si_3N_4 – SiC nanocomposite ceramic

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Abstract:

Friction and wear behaviors of silicon nitride ceramics reinforced by silicon carbide were studied. Friction and wear characterizations of nanocomposites were performed with a reciprocating ball-on-flat tribometer. Tribological tests were carried out with different frequencies and normal loads.

During tribological test, the antagonist was kept stationary and the composite specimen was on tangential cyclic motion using a crank system driven by an electric motor. Tangential force was measured by a load cell placed between the specimen holder and the crank slider system. A data acquisition system stored the output of the load cell. Before each test, the ball and the specimen surfaces were cleaned with ethanol then dried.

The tribometer generate linear reciprocating sliding motion between the contacting bodies. The chosen displacement amplitude for experimental tests was ±5 mm which give a sliding distance of 20 mm for each cycle. Tests were carried out under three different frequencies 0.25 Hz (i.e., 4s cycle duration), 0.75 Hz (i.e., 1.33s cycle duration) and 1 Hz (i.e., 1s cycle duration) who's the corresponding sliding velocity were 5 mm/s, 15 mm/s and 20 mm/s respectively. After each test, ZEISS Scanning Electron Microscope was used to observe wear tracks on the surface of specimens. The cross-section S (mm^2) of the wear groove was calculated from the established surface profile using SJ-210 Hand-held Roughness Tester. Experimental results have shown that tribological behaviors depend on normal load and sliding velocity. Specific wear rate decreases as the frequency increase. The lower friction coefficient is noted for 17N as normal load and 1 Hz frequency which is equal to 0.42 while the highest is noted at 0.25 Hz and equal to 0.92 at 33 N as normal.

The experimental results have shown also that:

- Normal load and sliding velocity have a significant influence on friction coefficients of tested materials.
- Friction coefficient increase with normal load from 0.36 to 0.55. The COF decrease with the increase of frequency from 0.9 to 0.45
- For 0.25 Hz frequency, friction coefficient is equal 0.93 which is very high and unacceptable by the most part of sliding contact.

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