Nanocomposites and nanomaterials

Tribological behaviour of Si_3N_4-based nanocomposites

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Nanocomposites made with non-oxide ceramic compounds exhibit extremely high hardness and wear resistance, low specific gravity, and maintain mechanical properties at high temperatures without oxidation [1–3]. Unique properties of Si_3N_4-based nanocomposites found an application in novel wear-resistive components, capable to withstand severe operation conditions such as cryogenic and high temperatures, boiling sea water, bases, and acids [2–4].

A comprehensive study was performed to evaluate tribological performances of newly developed Si_3N_4-based nanocomposites enhanced by either Si_3N_4 nanowhiskers or TiN nanoparticles and consolidated via a Rate Controlled Sintering and Spark Plasma Sintering techniques. A wear resistance of Si_3N_4-based nanocomposites was studied under dry sliding conditions using bearing steel, hard alloy, and Si_3N_4-based nanocomposites counterparts. The Si_3N_4–TiN nanocomposites exhibited low sliding friction coefficient <0.35 with hard alloy and <0.25 with Si_3N_4-based nanocomposite. A specific wear rate for the investigated nanocomposites was estimated to be in the range from $2 \cdot 10^{-7}$ $mm^3/N \cdot m$ to $5 \cdot 10^{-8}$ $mm^3/N \cdot m$. A film transfer from the Si_3N_4-based nanocomposites was found on the surface of the hard alloy counterpart. A chemical resistance of the Si_3N_4-TiN nanocomposite was investigated in aggressive mediums, such as acids and bases at elevated temperatures.

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