Nanocomposites and nanomaterials

Nanocomposites consolidated by microwave, spark plasma and rate-controlled sintering technique

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The feedback properties of particulate nanomaterials versus their structure parameters (grain size, pore size), were found much more sensitive than that in conventional materials. Theoretical predictions and experimental findings of extraordinary or, in the most cases, enhanced physical properties of nanostructured materials when their crystalline grains become less than 100 nm in size [1,2]. This became a great stimulus to develop several new powder consolidation techniques specifically designed for manufacturing dense nanomaterials [2-4]. Rate-controlled sintering, microwave and spark plasma sintering are considered the most promising methods to produce dense nanoctructured ceramics. Refractory compounds are used to demonstrate the application of methods for controlling the densification rate and nonlinear heating and loading conditions to produce dense nanocomposites with 30–70 nm grains. The mechanical and tribological properties of ceramics with grains from 50 to 500 nm in size are compared. The effect of increase in the mechanical (5–15%) and tribological (to 50%) characteristics of nanocomposites consolidated by rate-controlled sintering and modified nonlinear spark plasma sintering is studied. Nanocomposites based on refractory nitrides and borides are regarded as promising materials for creating a new generation of cutting tools, as well as wear-resistant ceramics for wide application.

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