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Development of Fe-Cu Based Sintered Composites Reinforced with Graphite and SiC for Automotive Clutch Applications

This study investigates the sintering behavior and mechanical characteristics of Fe-Cu matrix composites designed for high-performance automotive clutch systems. To achieve a balance between high friction stability and durability, graphite was incorporated at high concentrations (10 wt.% to 20 wt.%) alongside SiC particles. Graphite was specifically employed to utilize its cushioning effect during the powder compaction and sintering stages, facilitating stress distribution within the Fe-Cu matrix.
The microstructural evolution and crystallographic orientations were analyzed using Electron Backscatter Diffraction (EBSD) to evaluate the interfacial integrity between the Fe-Cu matrix and the carbonaceous reinforcements. Furthermore, the local tribological response and lubricating film formation were characterized via Lateral Force Microscopy (LFM).
Results showed that increasing the graphite content up to 20 wt.% significantly reduced the coefficient of friction (COF) due to the enhanced lubricity of the graphite phase, which is critical for smooth engagement in clutch applications. However, the inherent reduction in hardness caused by the soft graphite phase was compensated by the addition of SiC, which reinforced the Fe-Cu matrix and maintained structural rigidity.

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