Tribological and Electrical Performance of Graphene-Coated Carbon Fiber Bundles for High Current Rotating Systems

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Stable electrical contact under repetitive sliding and high current density remains a critical challenge in rotating electrical systems. Conventional metallic shaft grounding components are prone to severe wear and unstable contact resistance, limiting long-term reliability. Graphene, a two-dimensional material exhibiting high electrical conductivity and intrinsic solid-lubricant behavior arising from its layered structure, was employed as a functional interfacial coating on carbon fiber bundle architectures to enhance tribological and electrical stability. Pin-on-disc evaluation demonstrated that graphene-coated bundles maintained a stable low friction coefficient with reduced wear loss compared to uncoated counterparts, attributed to lamellar shear and the formation of a protective transfer film during sliding. Electrical measurements revealed suppressed contact resistance variation after repeated friction cycles, indicating sustained conductive pathway integrity. The interaction between the compliant bundle geometry and the graphene network dissipates mechanical stress while preserving conductive continuity.

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References

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Figures

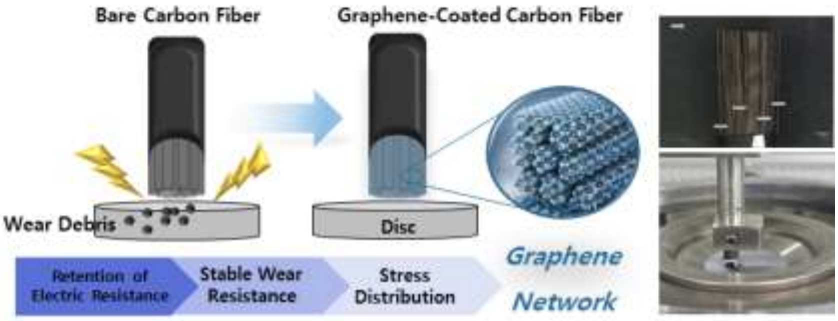

Figure 1: Tribological Mechanism of Enhanced Carbon Fibers