



Materials and Systems Research, Inc.

Functionally Graded Si-C

MSRI has developed a class of functionally-graded SiC composites that exhibit high strength, damage resistance and reliability. The composites consist of SiC-TiB₂ or SiC-TiC substrates with a thin surface layer of pure a- or b- SiC. The pure SiC surface layer ensures good corrosion and sliding-wear resistance while the residual surface compression induced in the SiC layer (due to the thermal-expansion mismatch with the substrates) enhances strength, damage-resistance and reliability of the components.

Testing has demonstrated a doubling of strength, damage resistance, and erosion resistance for the functionally-graded composites (compared to monolithic SiC ceramics) while maintaining a corrosion resistance comparable to that of commercial-grade SiCs.



MSRI has fabricated a variety of engineering components including balls and seats for shut-off valves and roller bearings from the graded composites. Balls made of a SiC/SiC-15 vol% TiB₂ composite withstood a torque of 6800 in.lbs in prototype destructive tests (ordinary SiC balls fail at about 3300 in.lbs). Rolling elements made from SiC/SiC-30 vol% TiC had a mean fatigue life that was two orders of magnitude greater than the life of ordinary monolithic SiC elements.

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