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Surface degradation of aluminium matrix composites reinforced by WC nanoparticles and aluminide particles

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Abstract:

The present work is part of a greater effort to fabricate particulate reinforced AMCs with the following objectives: (i) low cost conventional casting assisted by stirring and salt fluxing for improved particle wetting and distribution; (ii) addition of submicron carbide particles aiming at combining the advantages of ultra-fine dimensions with the excellent intrinsic properties of carbides and the good particle-liquid metal wetting compatibility of carbides with a strong metallic character; (iii) employment of ex-situ reinforcement volume fractions sufficiently low to limit segregation; (iv) optimization of surface property performance by attaining extra in-situ reinforcement. Within the above framework, aluminum matrix composites were prepared by adding submicron sized WC particles into a melt of Al 1050 under mechanical stirring, with the scope to determine: (a) the most appropriate salt flux amongst KBF_4, K_2TiF_6, K_3AlF_6 and Na_3AlF_6 for optimum particle wetting and distribution and (b) the maximum carbide volume fraction (CVF) for optimum responses to surface properties. The nature of the wetting agent notably affected particle incorporation, with K_2TiF_6 providing greater particle insertion. A uniform aluminide and WC particle distribution was attained. Sliding wear testing showed that at low CVFs (≤ 1.5%), crack propagation was delayed by the dispersion; at high CVFs (2.0%), crack propagation was obstructed by a tribolayer. Reverse polarization in 3.5 wt.% NaCl revealed impurity-due intergranular corrosion. The reinforcement/matrix interphase remained corrosion-free.