Optimizing the La_2O_3 concentration for enhanced thermal and wear resistance of Ti(C,N)-based cermets

Ti(C,N)-based cermets are important materials for cutting tools and wear-resistant applications because of their excellent hardness, and thermal stability. Nevertheless, enhancing their efficiency by improving the microstructure, mechanical properties, and wear resistance is still complicated. This work examined how La_2O_3 addition affects the microstructure, mechanical properties, thermal stability, and tribological performance of Ti(C,N)-based cermets. Ball milling and vacuum sintering were used to produce the samples containing various La_2O_3 contents. Ball-on-disk wear tests were used to examine the tribological properties of Ti(C,N)-based cermets. The incorporation of La_2O_3 improved the microstructure of samples by refining the grain size of hard phase. La_2O_3 enhanced the mechanical properties of Ti(C,N)-based cermets, achieving a maximum Vicker's hardness of 1640 Kg_f/mm^2 (L1 cermet with 0.5 wt% La_2O_3) and fracture toughness of 10.0 $MPa.m^{1/2}$ (L3 cermet with 1.5 wt% La_2O_3). However, the incorporation of excessive La_2O_3 minimizes transverse rupture strength (TRS) from 1495 MPa (T sample) to 900 MPa (L3 cermet). Among these three La_2O_3 contents, Ti(C,N)-based cermet incorporated with 1.0 wt% La_2O_3 (L2 cermet) has the highest wear resistance, with a wear rate of 2.49 × 10 $mm^3/(Nm)$.

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