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Surface Properties, Friction, Wear Behaviors of the HOVF Coating of T800 Powder and Tensile Bond Strength of the Coating on Ti64

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Abstract: Micron-sized Co-alloy T800 powder was coated on Inconel718 (IN718) using high velocity oxygen fuel (HVOF) thermal spraying by the optimal coating process (OCP) determined from the best surface hardness of 16 coatings prepared by Taguchi program. The surface hardness improved 140-160 % from 399 Hv of IN718 to 560-630 Hv by the coating. Porosity of the coating was 1.0-2.7 %, strongly depending on spray parameters. Both friction coefficients (FC) and wear traces (WT) of the coating were smaller than those of IN718 substrate at both 25 ^{O}C and 538 ^{O}C. FC and WT of IN718 and coating decreased with increasing the surface temperature. Tensile bond strength (TBS) and fracture location (FL) of Ti64/T800 were 8,770 psi and near middle of T800 coating respectively. TBS and FL of Ti64/NiCr/T800 were 8,740 psi and near middle of T800 coating respectively. This showed that cohesion of T800 coating was 8,740-8,770 psi, and adhesion of T800 on Ti64 and NiCr was stronger than the cohesion of T800.

1. Introduction

Electrolytic hard chrome plating (EHC) has been used for surface hard coatings. EHC has raised health and environmental problems, because it emits Cr^{6+} ion mist, a known carcinogen [1, 2]. As an alternative hard coating, HVOF thermal spray coating of T800 powder has been studied for the improvement of sliding machine components such as air bearing spindle, which operates without any lubricants. Surface properties, friction, wear and adhesion on Ti64 substrate have been investigated.

2. Results and discussion

The T800 powders (in wt% 50.5% Co, 28.4% Mo, 17.6% Cr, 3.1% Si, 0.7% Fe, 0.7% Ni) with various sizes were molten, partially molten or soften during the flight time of 0.1-1 ms by the high flame temperature of up to 3,500 ^{O}C [1, 2]. The hot splats of various sizes and velocities were accelerated to the speed of up to 1,000 m/s, and impacted upon the cool coating surface, forming coating [1-4]. The hardness 560-640 Hv of the coating is much higher than the substrates of IN718 (399 Hv) and Ti64 (350 Hv). Porosity of the coating was 1.0-2.7 %, strongly depending on spray parameters. As shown in Fig.1, both FC of coating and IN718, and WT of coating and counter sliding surface of SUS 304 decreased with increasing surface temperature form 25 ^{O}C to 538 ^{O}C, because the lubricant function of cobalt oxides was higher at the higher temperature. As shown in Fig. 2, TBS and FL of Ti64/T800 were 8,770 psi and near middle of T800 coating respectively. TBS and FL of Ti64/NiCr/T800 were 8,740 psi and near middle of T800 coating respectively. This showed that cohesion of T800 coating was 8,740-8,770 psi, and adhesion of T800 on Ti64 and NiCr was stronger than the cohesion of T800. Bond coat NiCr had no effect on the adhesion of the coating.

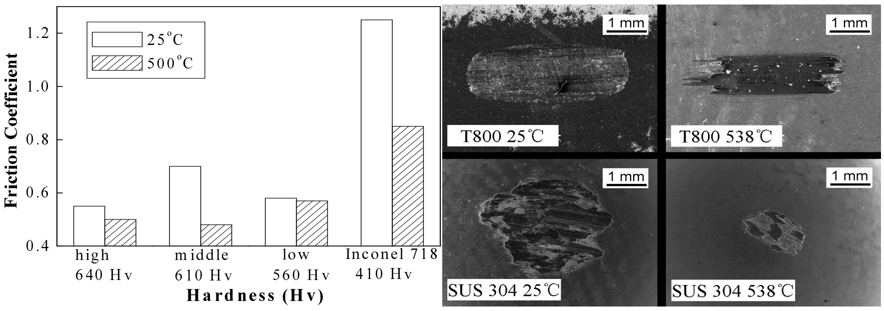

Fig. 1 Friction coefficients and wear traces

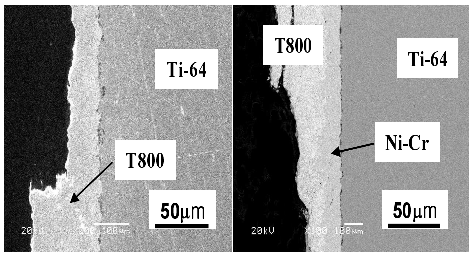

Fig. 2 Cross section of fractures: Ti64/T800 and Ti64/NiCr/T800

3. Conclusions

The hardness of coating 560-630 Hv was 140-160% higher than IN718 substrate. Porosity of the coating was 1.0-2.7 %. Both FC of coating and IN718, and WT of coating and counter sliding surface of SUS 304 decreased with increasing surface temperature form 25 ^{O}C to 538 ^{O}C. The cohesion of T800 coating was 8,740-8,770 psi, and adhesion of T800 on Ti64 and NiCr was stronger than the cohesion of T800. T800 coating is strongly recommended as a protective coating on sliding machine components.

4. References

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