SLIDING WEAR EVALUATION OF HOT ISOSTATICALLY PRESSED (HIPED) THERMAL SPRAY CERMET COATINGS

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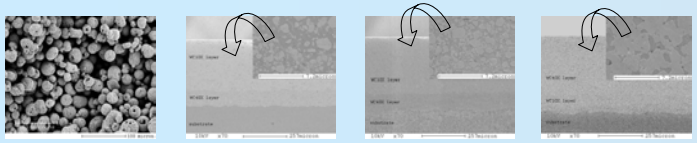
This poster presents preliminary results on the effect of HIPing process on the sliding wear resistance of the WC-NiCrBSiFeC coatings. Results are discussed in terms of microstructural investigations, phase transformation, mechanical properties and residual stress investigations.

EXPERIMENTAL PROCEDURE:

The material used in this study was functionally graded WC-NiCrBSiFeC coating sprayed on the shot blasted surface of 31mm diameter, 440-C steel discs by the HVOF process - JP5000 system (100μm WC-40wt%Ni based alloy on the substrate, followed by 300μm WC-10wt%Ni based alloy). The coatings were treated for one hour in argon environment at temperatures of 850° C and 1200 ° C and pressure of 150MPa. Sliding wear tests were carried out using a reciprocating ball-on-plate tribometer, instrumented to measure the frictional force via a load cell The counterbodies were 440C steel and silicon nitride ceramic balls. The ball bearing the normal load is stationary, while the coated disc has a sliding speed of 0.012m/s at the centre of the wear scar disc. The tests were performed in dry contact conditions at ambient temperature and humidity under 12.26 and 22.07N, which corresponds to a stress in the range of 180-220MPa and 210-255MPa for contact against steel and ceramic balls, respectively.

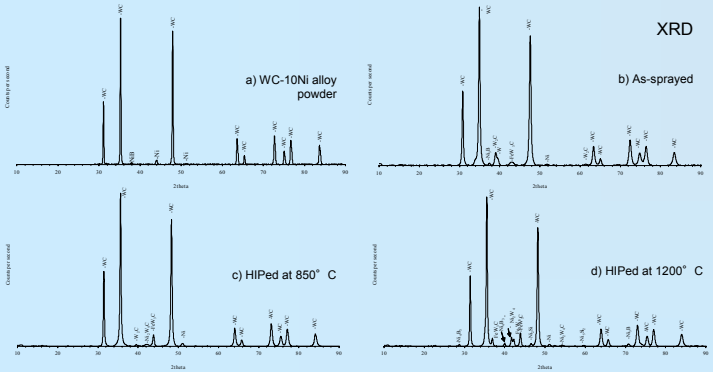
EXPERIMENTAL RESULTS:

SEM

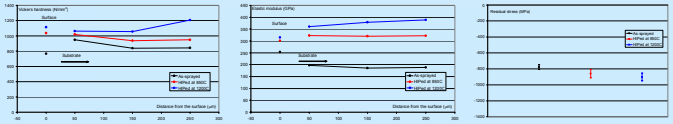


a) WC-10Ni alloy powder b) As-sprayed c) HIPed at 850C d) HIPed at 1200C

XRD

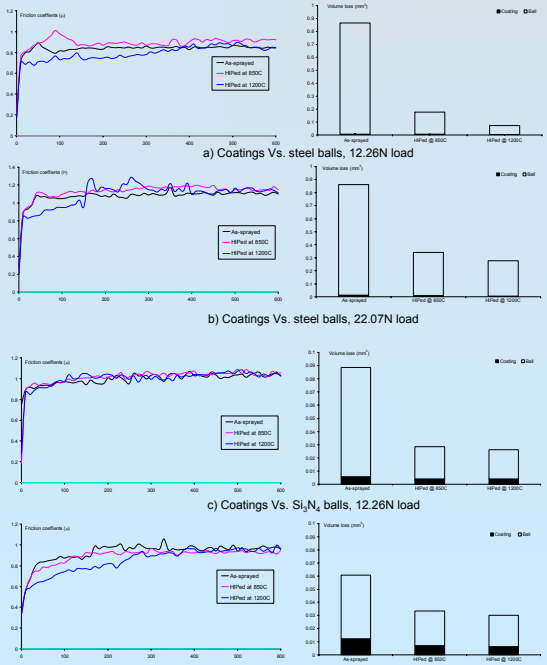


Mechanical properties and residual stress



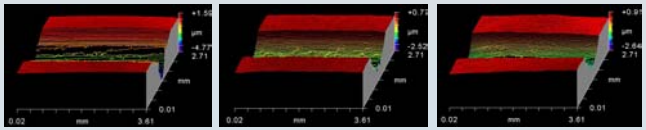
a) Through depth microhardness b) Through depth elastic modulus c) Residual stress measurement

Friction and wear measurements



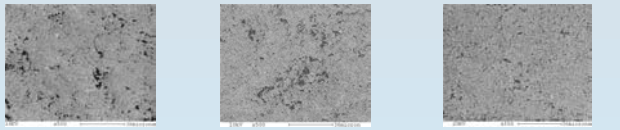
Post test investigation

Interferometer



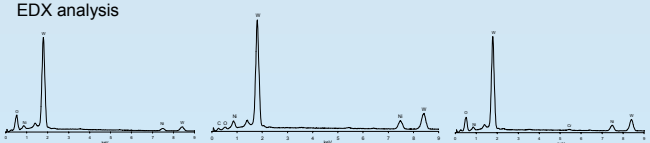
a) As-sprayed Vs. Si_3N_4 ball b) HIPed at 850ºC Vs. Si_3N_4 ball c) HIPed at 1200ºC Vs Si_3N_4 ball

SEM micrographs



a) As-sprayed Vs. steel ball b) HIPed at 850 ° C Vs. steel ball c) HIPed at 1200 ° C Vs. steel ball

EDX analysis



a) As-sprayed Vs. steel ball b) HIPed at 850 ° C Vs. steel ball c) HIPed at 1200 ° C Vs. steel ball

CONCLUSIONS:

Preliminary results indicate that the sliding wear performance of functionally graded WC-NiCrBSi coatings can be improved by HIPing post-treatment.

- Results indicate that, increase in HIPing temperature improved the sliding wear resistance of the coating. However in the particular case of contact between the coatings and a hard counterbody e.g. ceramic ball, preliminary results showed that intermediate temperature of around 850° C provided the best sliding wear resistance.
- Microstructural investigations show that considerable diffusion at the interface of coating layers take place, especially at higher temperatures.
- Changes in coatings Young`s modulus and hardness are indicative of the microstructural changes seen in XRD pattern.

This investigation confirms that uncapsulated HIPing can be successfully applied to post treat thermal spray coatings by appropriate design of functionally graded coatings and HIPing conditions.

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