Effects of Surface Roughness on the Durability of PDA/PTFE Solid Lubricant Coatings on 60NiTi

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Introduction

- 60NiTi is a promising candidate material for bearings and mechanical components.
- The friction and wear of 60NiTi in dry contact is very high.

Objectives

- Develop processes to coat 60NiTi with PDA/PTFE
- Experimentally evaluate the tribological properties of 60NiTi + PDA/PTFE
- Evaluate the effects of 60NiTi surface roughness on PDA/PTFE coating durability

60NiTi Surface Roughness Preparation

- 320 grit sandpaper, 1 lb, 3 min
- Polycrystalline diamond suspension, 6 lb, 8 min
- Colloidal silica suspension, 4 lb, 5 min

- 320 grit sandpaper, 1 lb, 1 min
- Polycrystalline diamond suspension, 2 lb, 1 min
- Colloidal silica suspension, 2 lb, 1 min

- Polished to Si
- Polished to S1
- Polished to S2
- Polished to S3
- Polished to S4

Line Roughness of Polished 60NiTi Sample Surfaces

- A Buehler EconMet 300 Polisher is used to polish and texture the 60NiTi surfaces.
- A DekTak 150 Surface Profiler is used to measure line roughness of the surfaces.

Friction and Durability

- The average coefficient of friction for all samples tested was around 0.1
- This corresponds to a reduction of over 80% in COF compared to 60NiTi in unlubricated sliding behavior

PDA/PTFE Coating Durability Tests on 60NiTi Substrates with Various Surface Finishes

- Surface roughness has a large effect on the durability of PDA/PTFE coatings on 60NiTi
- On average, PDA/PTFE on S3 and S4 (roughest samples) lasted over 24 times longer than PDA/PTFE on S1 (smoothest sample)
- There was no statistical difference in the PDA/PTFE coating durability on S3 and S4 when tested perpendicular to polishing lines
- The direction of motion relative to the direction of polishing lines has a large effect on the durability and standard deviation for the rougher samples

Conclusions

- Study the durability of 60NiTi + PDA/PTFE coatings polished to roughness between that of S2 and S3
- Increase the PDA coating thickness on 60NiTi
- Study the mechanical properties of 60NiTi + PDA/PTFE through nanoinindentation

Future Work

- Study the durability of 60NiTi + PDA/PTFE coatings polished to roughness between that of S2 and S3
- Increase the PDA coating thickness on 60NiTi
- Study the mechanical properties of 60NiTi + PDA/PTFE through nanoindentation

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References