The Effect of Tribological Fretting on Ti6Al4V Alloy with Varying pH and Frequency

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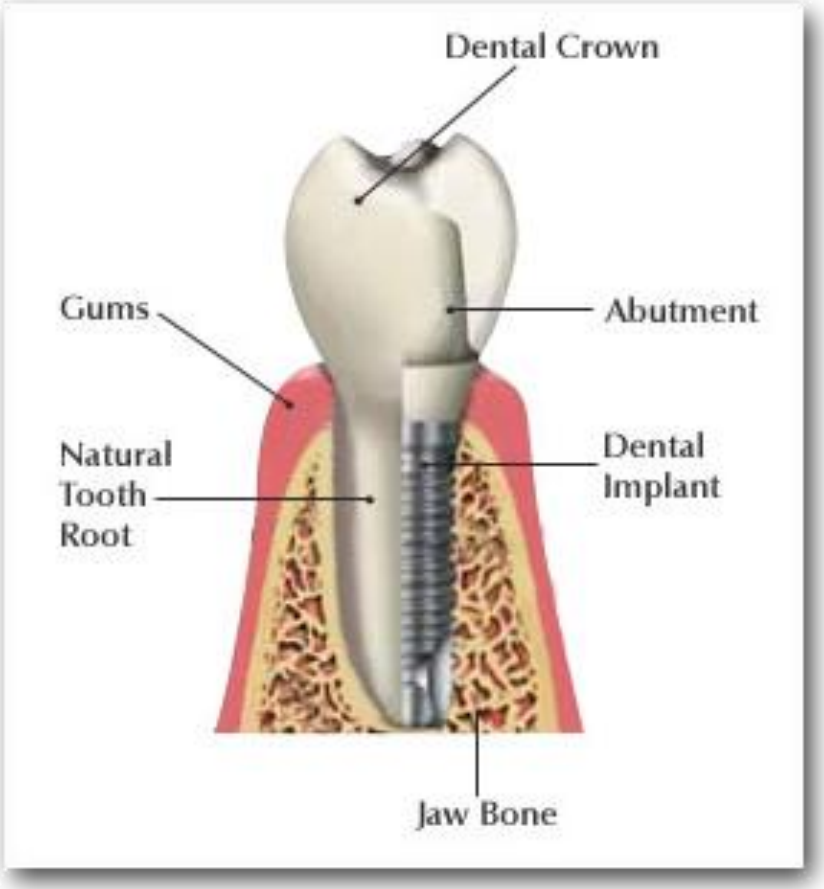
February 21, 2014

Introduction and Motivation

- Dental Implants consist of three main elements – the screw into the jaw, the dental crown, and the abutment which connects the two.
- The abutment is typically made of titanium type V alloy (Ti6AlV4).



http://www.pacificparkdental.com/images/dental-implant.png

Introduction and Motivation

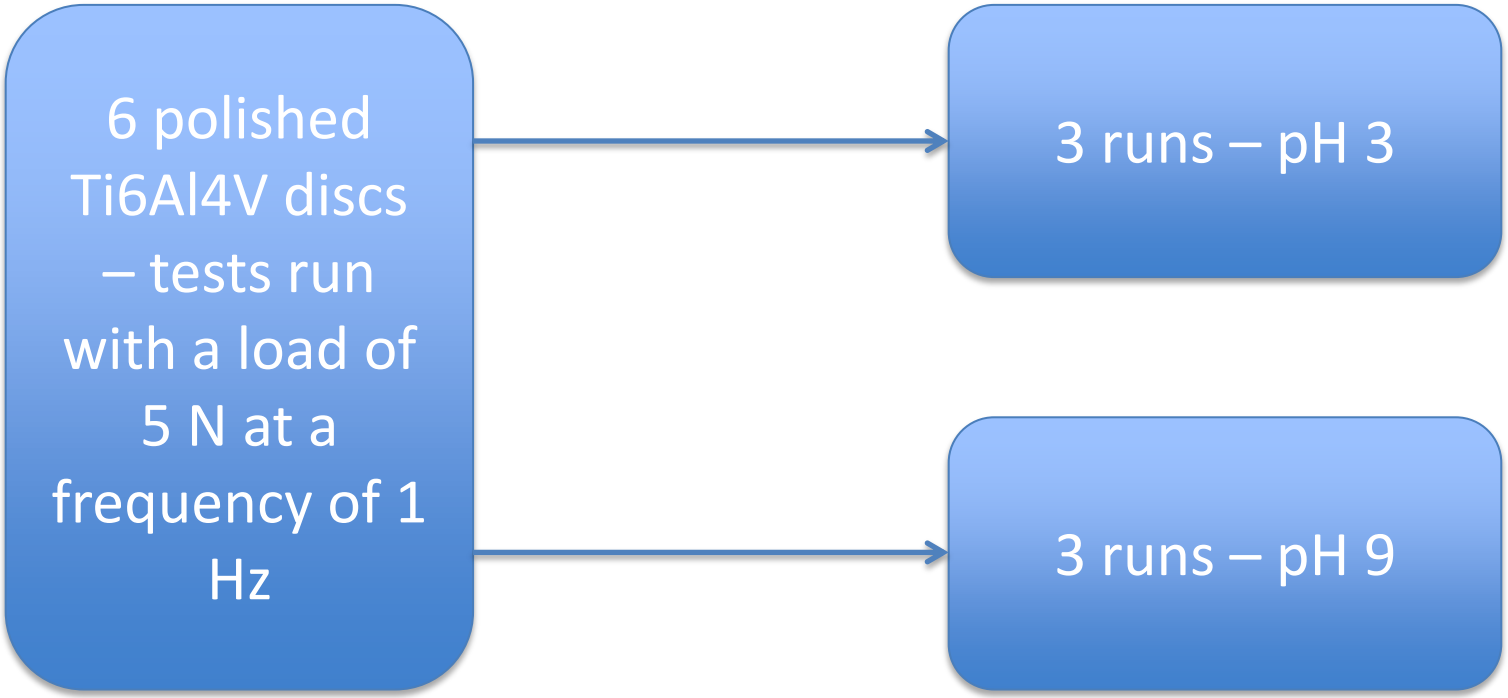
- In the crown of the dental implant, cracks can form, causing saliva to leak into the abutment
- At different pH levels, studies[1] have shown that Ti6AlV4 alloy exhibits greater wear and corrosion at pH levels closer to the pH of saliva (6.2-7.4) than more acidic pH levels.
- When the Ti6AlV4 becomes significantly corroded, the implant can fail.

[1]Mathew MT, Abbey S, Hallab NJ, Hall DJ, Sukotjo C, Wimmer MA. Influence of pH on the tribocorrosion behavior of CpTi in the oral environment: synergistic interactions of wear and corrosion. J Biomed Mater Res B Appl Biomater. 2012;100:1662-71.

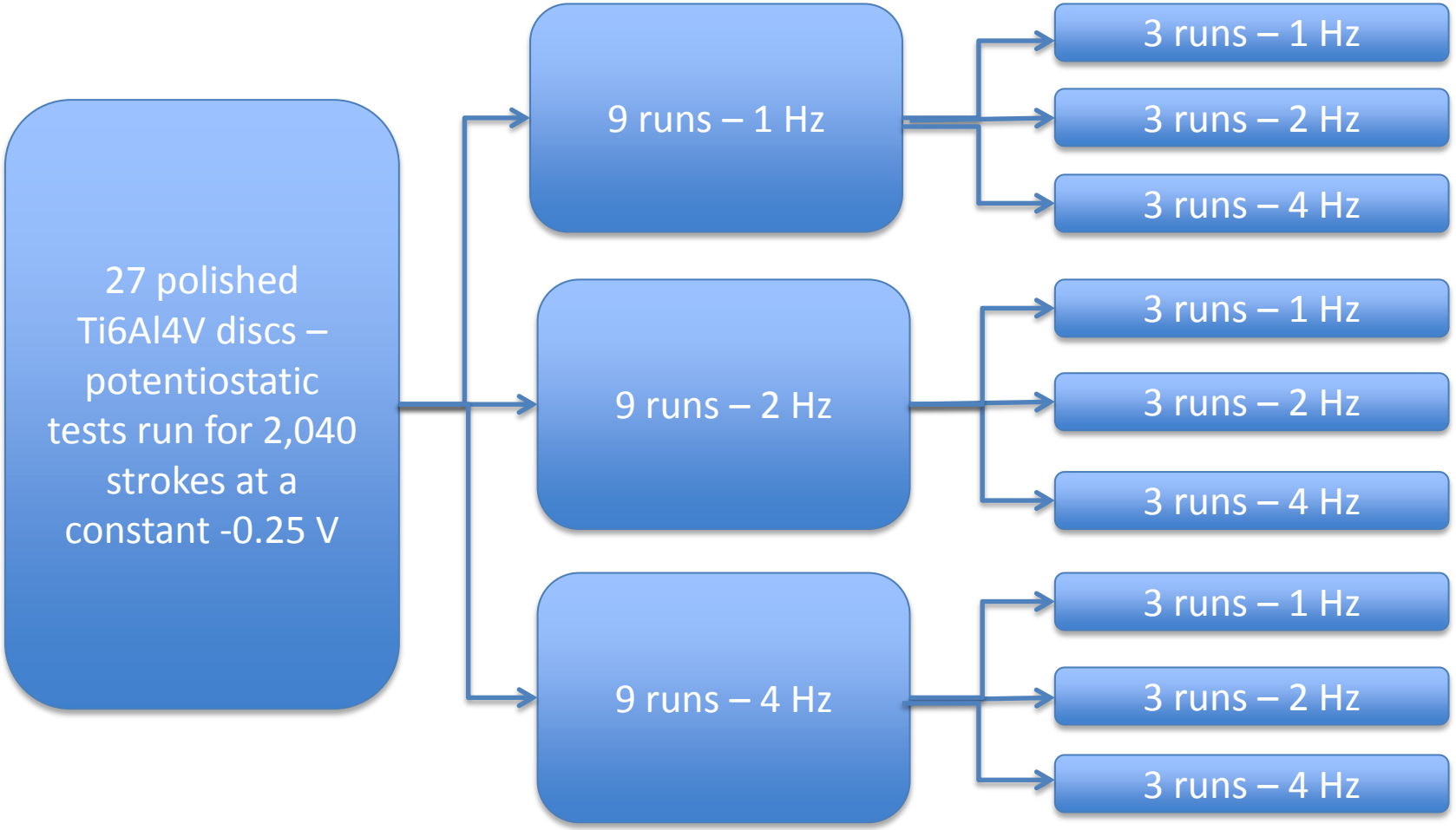
Introduction and Motivation

- Observe how varying pH levels and frequencies effect wear and corrosion (tribocorrosion) of Ti6AlV4 alloy
- Ceramic pin (zirconium oxide) will stroke with a 1 mm length at frequencies of 1, 2, and 4 Hz in artificial saliva solution of pH 3, 6 and 9 for 2,040 strokes
- From the current given off during tribocorrosion and by measuring the total mass loss, mass loss due to wear and corrosion can be determined

Experimental Design, Part One – Open Current Potential (OCP) runs



Experimental Design, Part Two – Potentiostatic (PS) Tests



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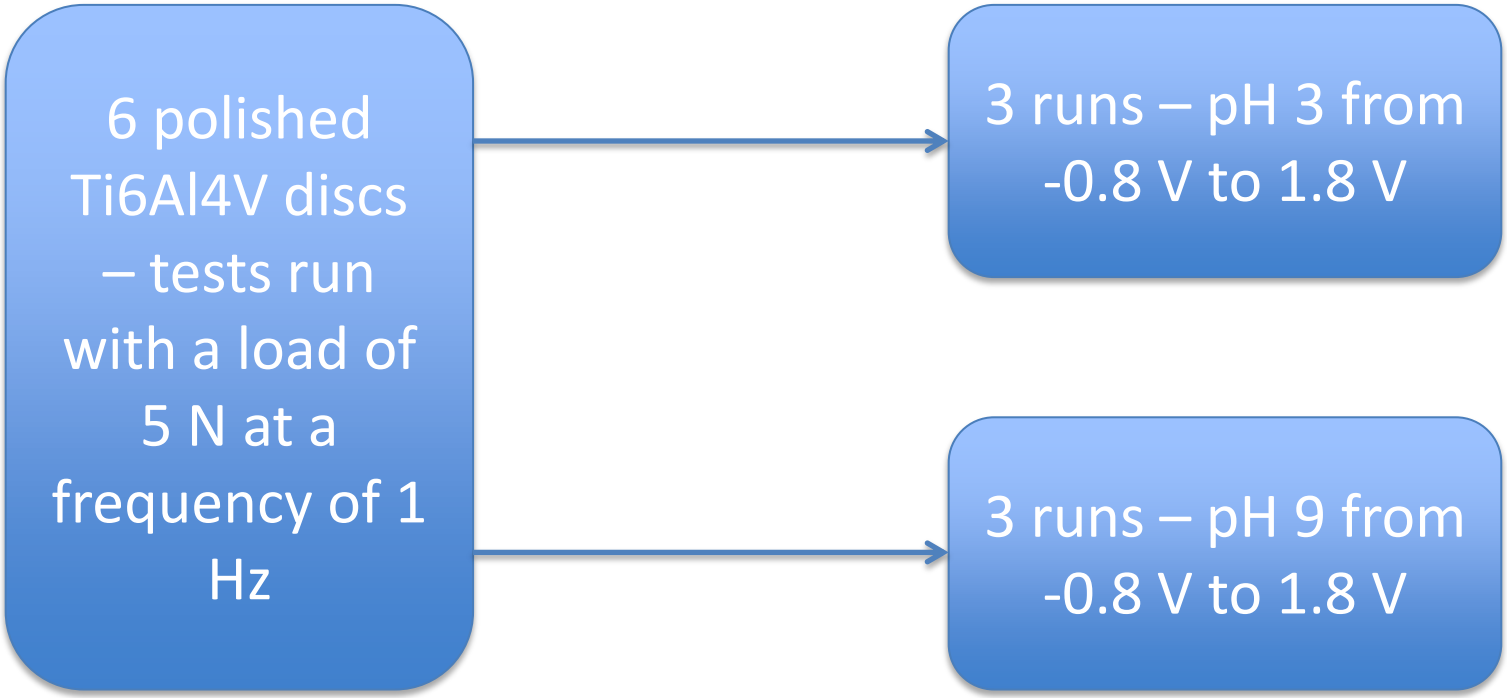

Preliminary Results

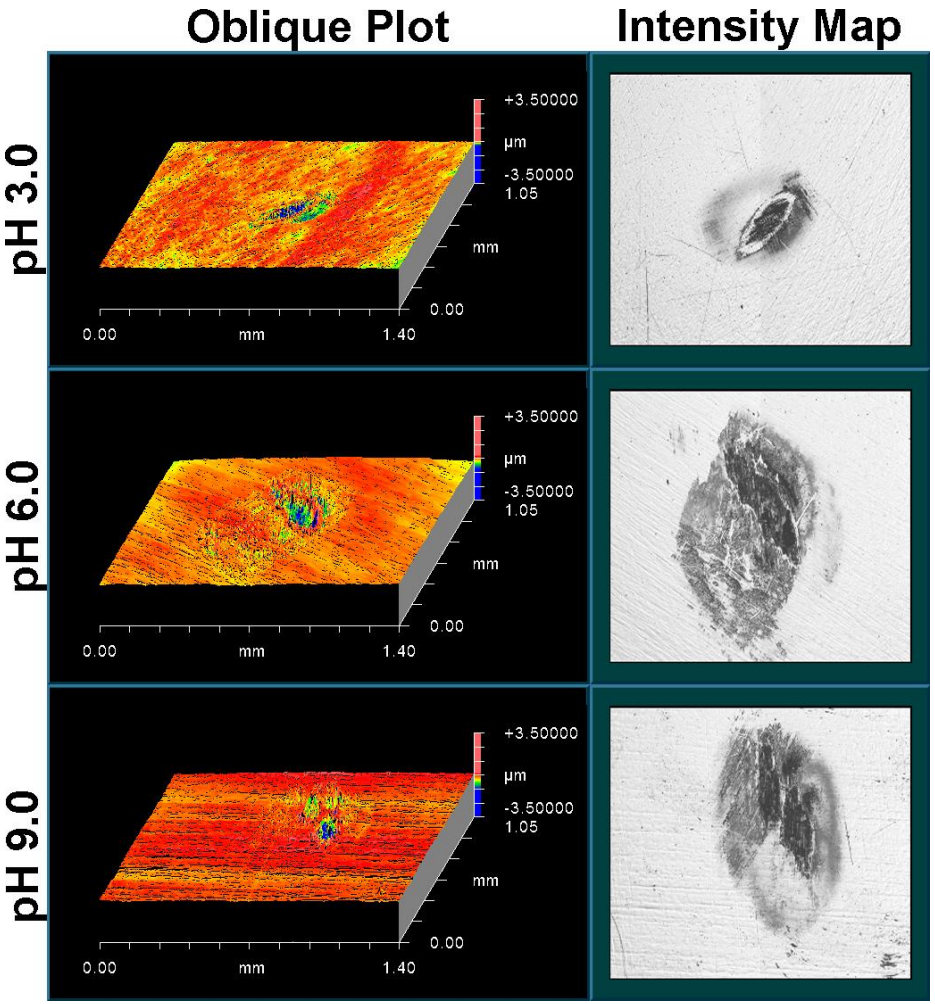

Fig. 1 – Zygo images of wear scars on Ti6Al4V alloy formed with a 5N load with a 1 Hz frequency.

Preliminary Results

- At 1 Hz, mass loss due to corrosion is the least in an artificial saliva solution of pH 3, with pH 6 and pH 9 about equally as corrosive
- Open current potentials are the greatest for pH 3, followed by pH 9, then pH 6, for both OCP and potentiostatic runs
- This follows data of previous studies which have observed that mass loss due to corrosion of Ti6Al4V is least in liquids that have a lower pH.

Next Steps

- Continue analysis of the wear scars with Zygo and SEM to observe mechanisms of fretting
- Analyze 2 Hz and 4 Hz runs to determine if Ti6Al4V samples in pH 3 have the least wear and corrosion at those frequencies
- Perform potentiodynamic runs

Acknowledgements

- DUCOM – Anirudh Dube and Andrea Bartolini
- Dmitry Royhman, John Grotberg, Arman Butt and Sweetu Patel
- Dr. Takoudis, Dr. Sukotjo, and Dr. Mathew
- UIC Department of Bioengineering
- UIC College of Dentistry
- Rush Department of Orthopedics