Fatigue property of anodized Ti-6Al-4V in biological environment

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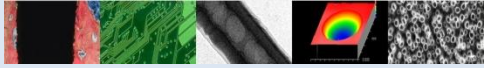


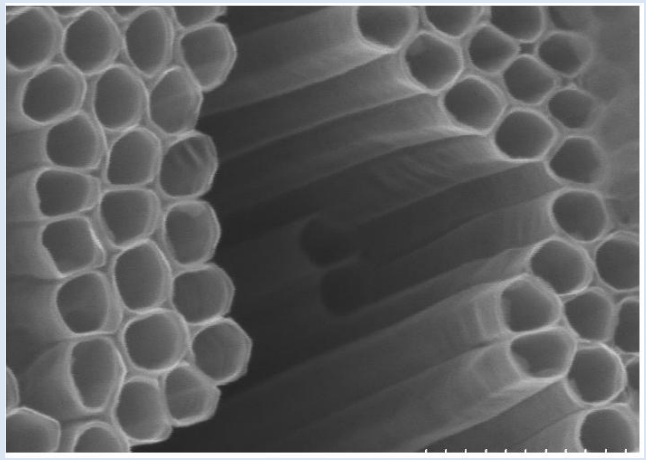
Ultimate goal

- Study the mechanical property, fatigue strength, of the titanium nanotubes (TNTs) formed from electrochemical anodization technique.

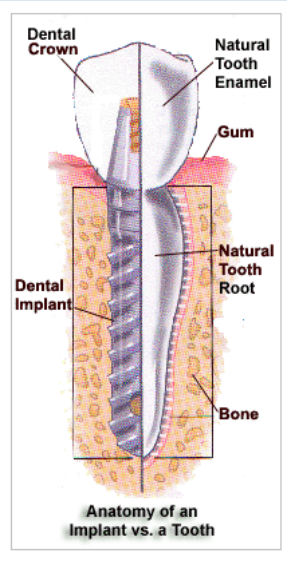
- To investigate the change in fatigue strength after various surface treatments including annealing, drug loading and silver doping.

Introduction

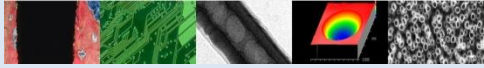
- Titanium nanotube (TNTs) is the current area of research for many fields because of its versatile properties
  - Biosensors
  - Solar cells
  - Photocatalysis
  - Photoelectrolysis
  - Biomedical implantation
    - Drug loading purposes (i.e. BMP that may enhance the bone-implant interaction, anti-inflammatory, infection control)
    - TNTs increases the surface area of the samples enabling cells to make proper adhesion with the sample.



Introduction

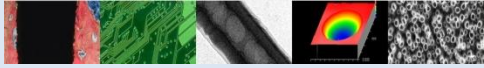


- TNTs for dental and hip implants, specifically at screw and stem part of the dental and hip implant, respectively.
- Its ability to withstand the cyclic loading, fatigue strength, during mastication (dental implant) and walking (hip implant).



Preliminary study

- Before investigating the behavior of TNTs upon cyclic loading, we designed a study to see the effect of constant loading on TNTs
- Hypothesis
  - As the amount of constant applied load increases on the press-fit anodized Ti-V in high density polyurethane foam, the electrochemical changes will increase and its surface impedance will decrease compared to non-anodized Ti-V rods.



Objectives

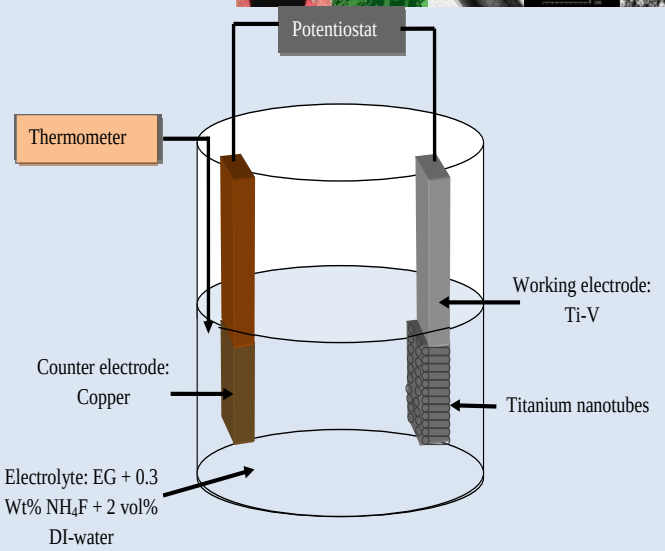
- How the Open Circuit Potential and Electrochemical Impedance Spectroscopy for changes during insertion test press fitted anodized and non-anodized Ti-V rods into various density solid polyurethane foam in PBS?
- How the OCP and EIS changes with increase in applied load from 50 N and up on anodized and non-anodized samples press-fitted into various density solid polyurethane foam in PBS?

Ti-V rods = 12 rods (round figure = 20 rods) (3 mm diameter, 8 cm length)

Machined and Anodized Samples

Rigid Polyurethane Foam 15, 20 and 50

PBS



Constant-compressive electrochemical Test

1. OCP measurement while submerging Ti-V rod in PBS (take measurement for 10 mins)

OCP = open circuit potential

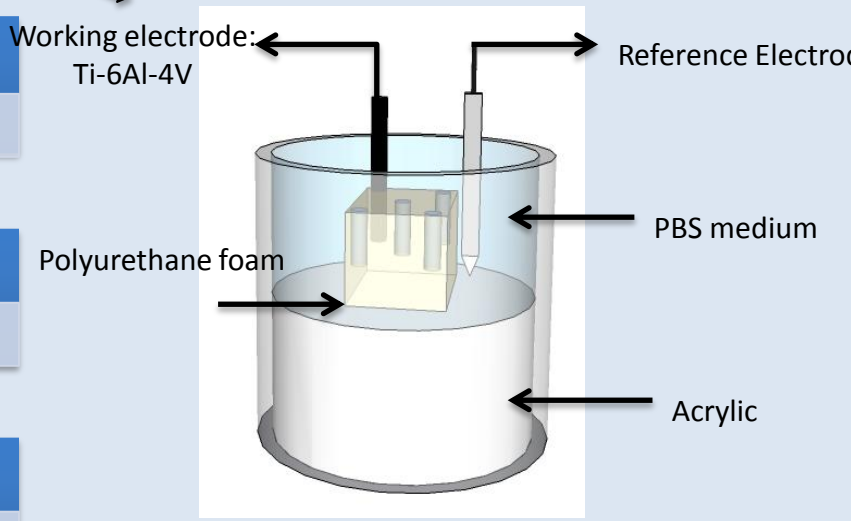
2. EIS --> OCP measurement during insertion test = take 5 mins to insert Ti-V rod 2 cm into Polyurethane foam--> EIS measurement

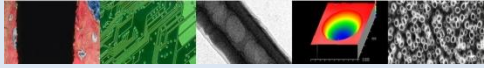
Ti-V rod will be press fit into the drilled hole

3. EIS --> OCP measurement after applying 50 N dead weight on inserted Ti-V rod (take measurement for 5 mins) --> then take EIS measurement

EIS = Electrochemical impedance spectroscopy

Repeat Step 3 with high load





Future work

- Perform the Cyclic loading experiment to study the fatigue property of electrochemically anodized titanium nanotubes.