

Carbide Derived Carbon (CDC) on Ti-alloy To Enhance Tribocorrosive Resistance at THR Interfaces

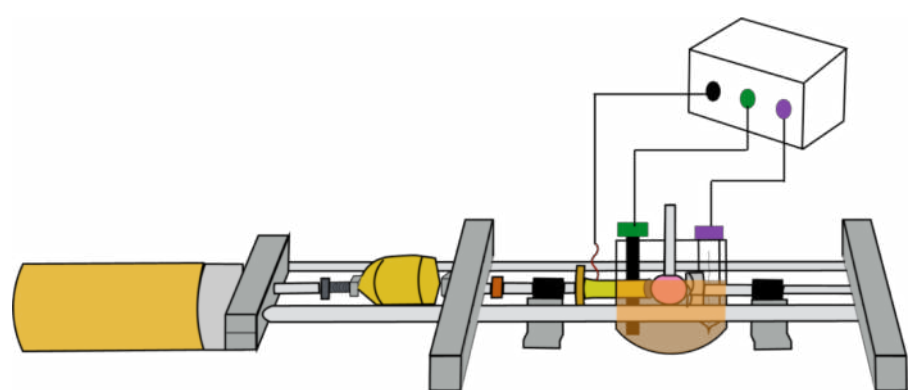
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Objective

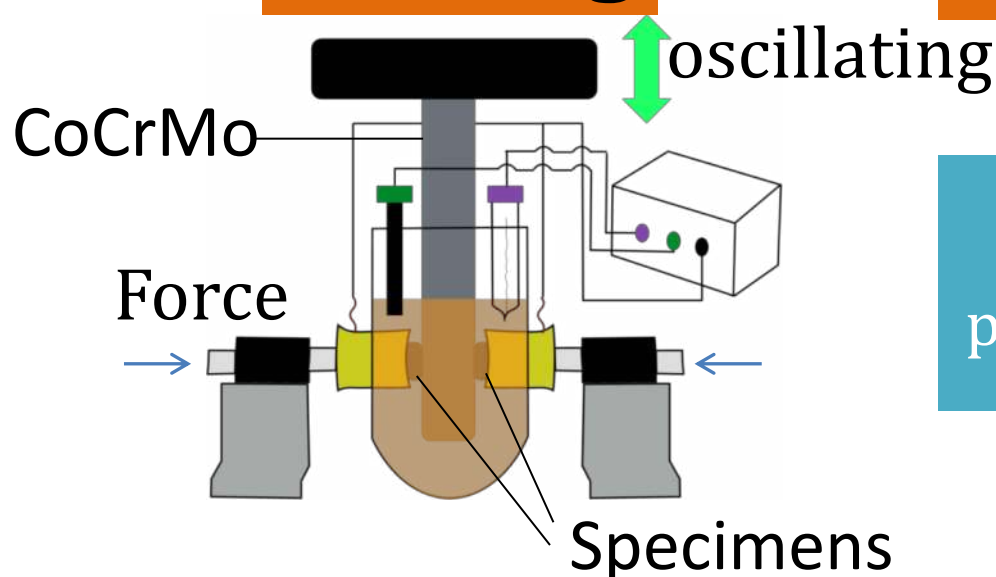
In this study, we hypothesize CDC can provide a good tribocorrosion resistance with acceptable biocompatibility on Ti6Al4V alloy. In order to test the hypothesis, CDC was tested in a tribocorrosion hip simulator under varying wear conditions and its biocompatibility was evaluated.

Methods

Tribocorrosion



Fretting



Biocompatibility

Cell proliferation
 Optical confocal images

Results

Characterization

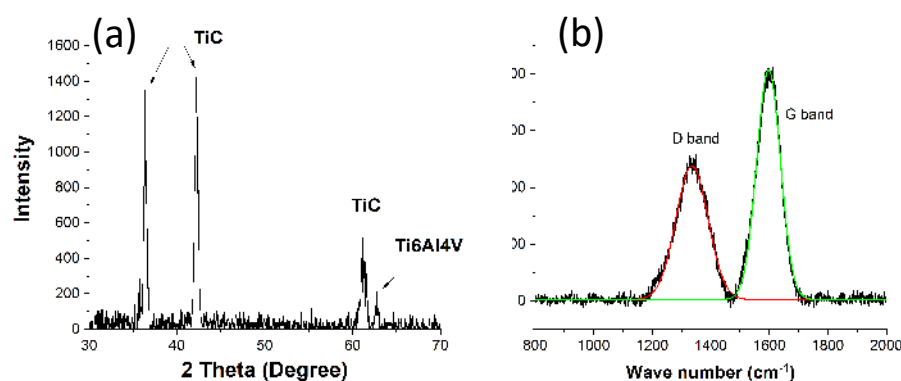


Figure 1. (a) XRD spectrum of carburized titanium after carburization (b) The Raman spectroscopy shows the success of fabricating CDC after chlorination.

Fretting

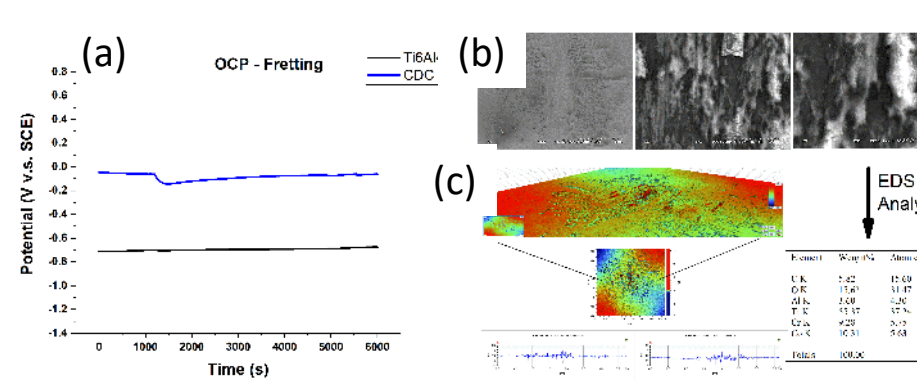


Figure 2. (a) The evolution of OCP in fretting experiments. (b) SEM images on Ti6Al4V fretting scar with EDS analysis. (c) 3D images of Ti6Al4V fretting scar.

Biocompatibility

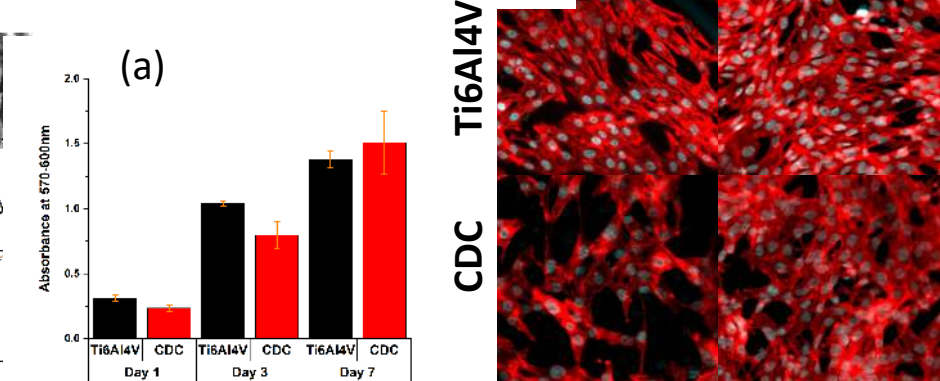


Figure 3. (a) The cell proliferation on Ti6Al4V and CDC specimens. (b) The confocal images of living cell on Day 1 and Day 5.

Tribocorrosion

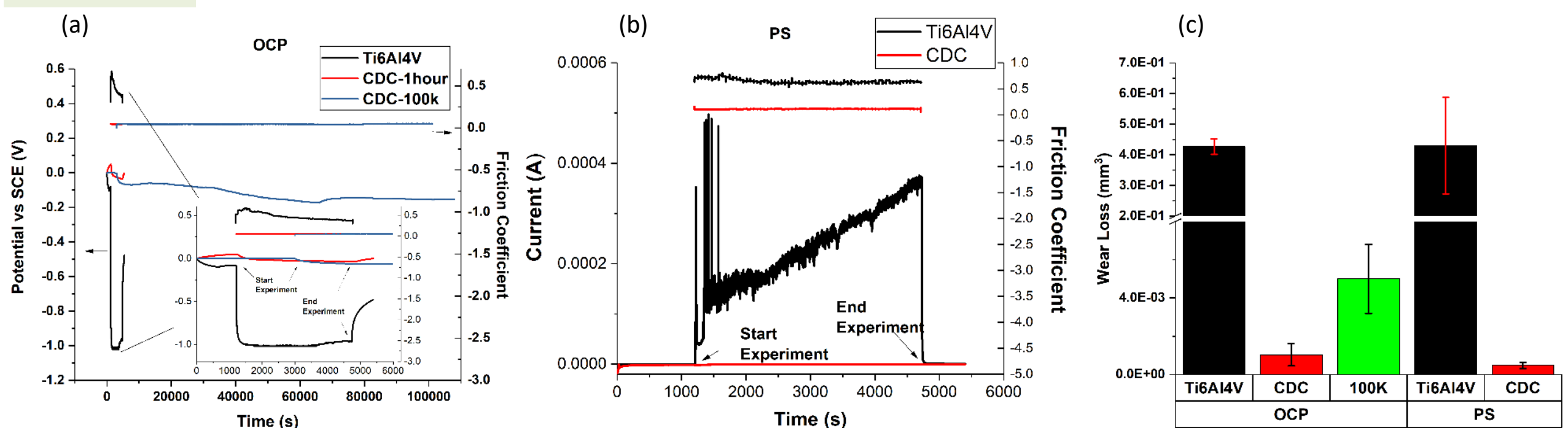


Figure 4. (a) The evolution of OCP and friction coefficient during tribocorrosion experiments for one hour and 100k cycles. The inset focuses on the first hour, which shows direct comparison between titanium alloy and two CDC groups. (b) The evolution of induced current and friction coefficient in PS condition of tribocorrosion experiments. (c) The wear loss volume after tribocorrosion experiments.

Discussion

- CDC has the steady protection in tribocorrosion and friction coefficient even after 100k cycles performance. Even though the amount of CDC decreases, the Raman mapping images directly show CDC not worn off after experiments, which demonstrates its sustainability.
- The fretting experiments between titanium alloy CoCrMo exhibits the transference of oxide of CoCrMo alloy on Ti6Al4V. The pits found in SEM and 3D profiler images presents the galvanic reactions observed in the OCP measurement.

Conclusion

- The CDC has been successfully fabricated on titanium alloy and improves titanium alloy tribocorrosion and fretting properties with the unchanged biocompatibility.
- Due to the great protection of CDC on titanium alloy, it might be highly possible to apply CDC on CoCrMo alloy, which might be the next step of current project.

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