Study of Improved Tissue Response on Titanium Alloys

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Objective

- Assisting graduate students in research of bone cell growth on titanium alloys
- Complete literature review to determine wt% Ta is appropriate for future testing in a Ti alloy
- Complete cell culture & staining on Ti-15 Mo grids

Literature Review

- Discussion of the microstructure and mechanical properties of Ti-Ta alloys
- Reports verified biocompatibility, corrosion properties, and improved mechanical properties as compared to other Ti alloys

Procedure

- **Sample Preparation**
  - Micro Laser Additive Manufacturing (m-LAM)
  - Deposits a material onto a substrate using a laser in an effort to create a three-dimensional porous object by building up layers of melted powdered material
  - Six Ti-15 Mo grids made for testing
  - Ti-Ta alloy grids made to study microstructure
- **Cell Culture**
  - seeded samples with CRL2593- mouse osteoblast differentiated cells
  - Two weeks allowed for cell growth
- **Osseointegration Verification**
  - Three stain tests: Van Kossa, Alizarin Red, and Alkaline Phosphatase staining

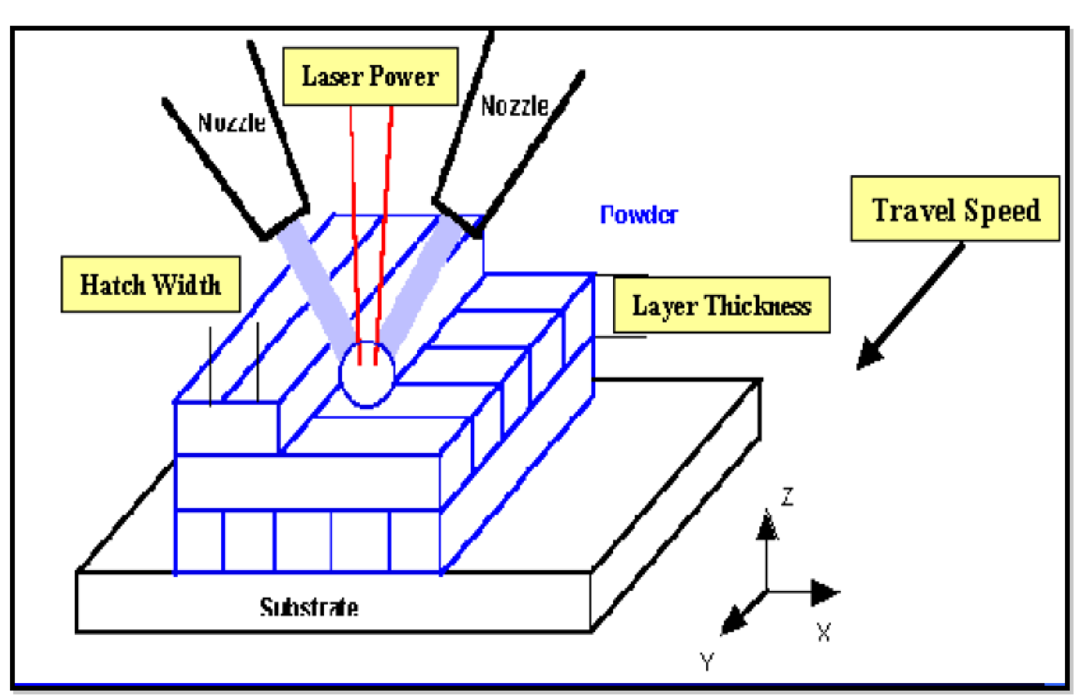

Figure 1. M-LAM deposition diagram

Background

Metals were originally chosen for study as a biomaterial based on their biocompatibility- that is the "acceptance of an artificial implant by the surrounding tissues and by the body as a whole." A biomaterial should not degrade within the human body or cause any adverse reactions. Additionally, metals are chosen based on their mechanical properties and corrosion resistance. The overall goal for new generations of biomaterials is to find devices and biomaterials with the ability to last longer, heal faster, and be more compatible for both older and younger members of the world's population.

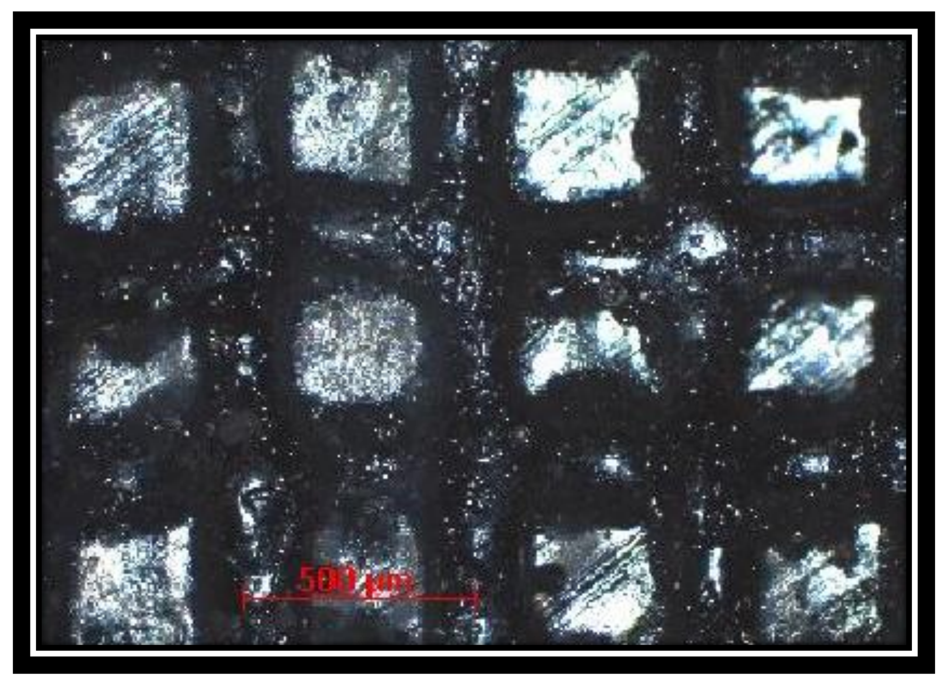

Figure 2. Ti-15Mo Grid used for cell culture

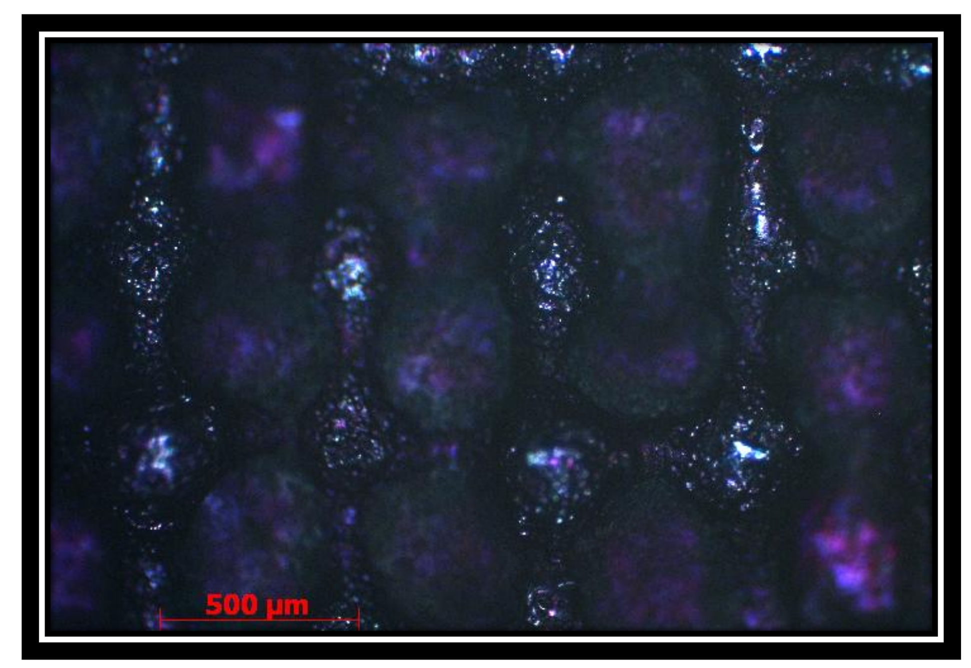

Figure 3. Ti-15Mo grid after Alkaline Phosphatase staining

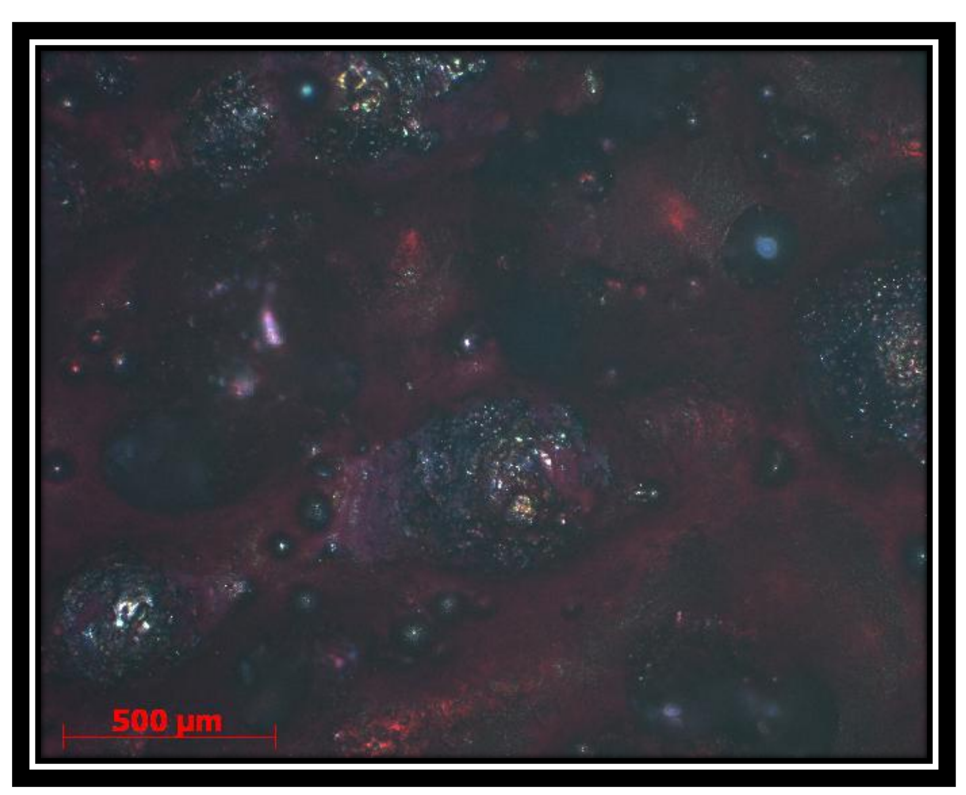

Figure 4. Ti-15Mo grid after Alizarine Red staining

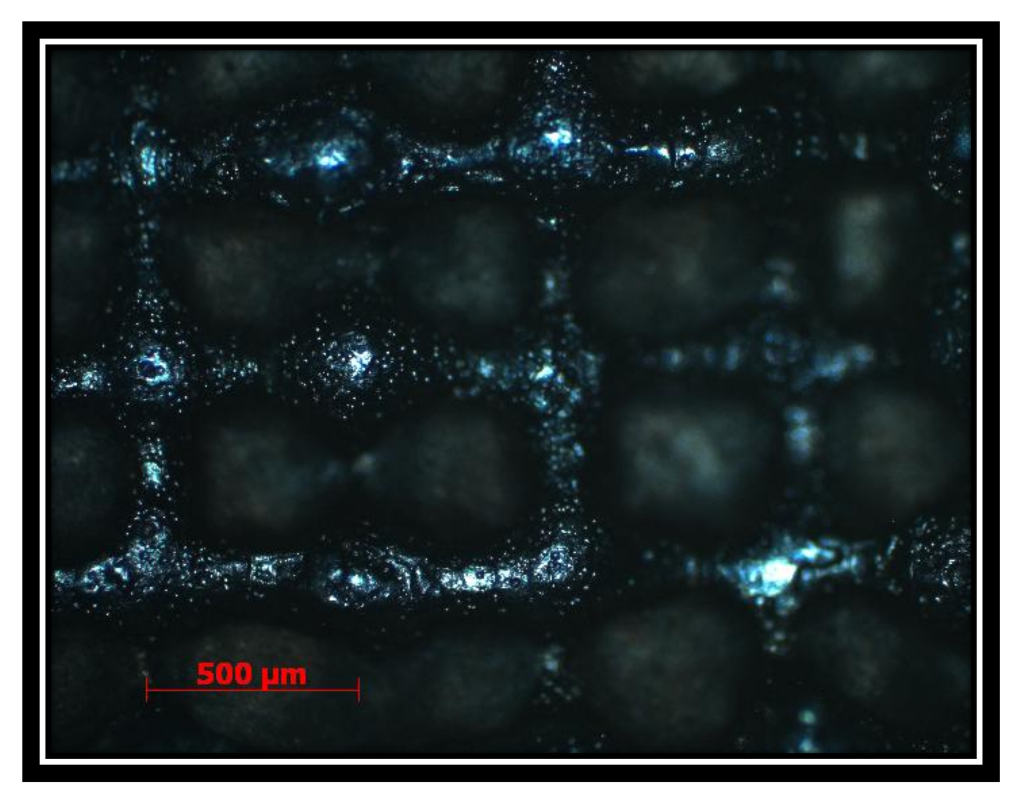

Figure 5. Ti-15Mo grid after von Kossa staining

Acknowledgements

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Results

- Qualitative data of staining confirms osteoblast proliferation on Ti-15Mo grid samples
  - Purple stain resulting from Alkaline Phosphatase stain confirmed the presence of a bone growth enzyme
  - Red stain resulting from Alizarin Red stain confirmed the presence of calcium deposits
  - Black/brown stain resulting from von Kossa stain further confirmed the presence of calcium deposits

Conclusion

•The stain tests were confirmation that two calcium salts- characteristic of osteoblasts- are present on the grids.

• The presence of the Alkaline Phosphatase enzyme additionally confirms bone cell growth

•Overall, the three tests together verify that osteoblasts are in fact growing on the Ti-15Mo grids

Future Work

•Nine additional Ti-15Mo samples will be made in order to collect quantitative data of osteoblast proliferation and adhesion at 1,4, and 7 day intervals

•Samples of Ti-Ta alloy will be made with pure Ta on a Ti-6Al-4V substrate and tested for osteoblast proliferation and adhesion