Osteoarthritis (OA) is a degenerative joint disease that affects millions of people worldwide. It is characterized by pain, stiffness, and decreased range of motion in one or more joints. The disease is caused by the breakdown of cartilage, the lining of the joint, leading to bone-on-bone friction and further cartilage wear. OA is one of the most common forms of arthritis and affects millions of people in the United States each year. It is estimated that 27 million Americans are affected by OA, with this number expected to increase as the population ages.

**Introduction**

- Osteoarthritis - degradation of cartilage and bone
  - Affects 27 million Americans
  - Costs U.S. $89.1 billion per year

- 285,000 total hip and 600,000 total knee replacements completed each year in the U.S.
- Titanium metal used as implant biomaterial in replacement surgeries because:
  - Good mechanical properties
  - High strength-to-weight ratio
  - Corrosion resistance
  - Excellent biocompatibility

- Anodic Oxidation

- Laser Deposition

**Project Objective**

- To increase integration between bone and implant:
  - Micro-scale surface features foster bone ingrowth
  - Nano-scale surface features increase osteoblast function
  - Combine both features into single hierarchical coating to further improve osseointegration

**Procedure**

1. Laser Deposition → produces microgrid
2. Cleaning with wirebrush treatment
3. Anodic Oxidation → produces nanotubes
4. Cell Culture for cell morphology and cell viability

**Study Design**

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<thead>
<tr>
<th>GROUP NUMBER</th>
<th>MICROGRID</th>
<th>NANOTUBES</th>
<th>WIREBRUSH CLEANING</th>
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- Indicates presence of treatment

**Results**

- Representative SEM Images of Microgrid and Nanotubes

- Wirebrush Treatment

- Contact Angles

**Conclusions**

- Wirebrush treatment was able to dramatically decrease unmelted laser deposition particles.
- Wirebrush treatment or the presence of nanotubes considerably lowered contact angle.
- Osteoblasts on all samples showed signs of both cell adhesion and spreading.
- Samples with nanotubes had significantly greater cell densities compared to samples with no nanotubes.
- Samples that underwent wirebrush treatment had greater cell densities compared to samples without wirebrush treatment.

**Representative Cell Morphology SEM Images**

- Mouse pre-osteoblast cells
- $10^5$ cells seeded per sample
- Incubated for 4 hours before imaging

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**References**