Dielectric Barrier Discharge Plasma Treatment of 3D Printed Polylactic Acid (PLA)

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Need:
- 3D printed PLA structures are being investigated as a method of creating orthopedic structures, but suffer from poor adhesion between printed layers that can fail when subjected to shear stress.

Approach:
Increased roughness has been linked to increased shear modulus, plasma treatment has been found to increase roughness. Will adapt a 3D printer and plasma discharge device to allow for concurrent printing and treatment of PLA.
- Unchanged chemical composition
- Roughness increased by factor of 2 from control
- Shear modulus significantly greater than 18.26MPa

Solution:

Results/Impact:
Unchanged chemical composition
15 sec of plasma treatment surface roughness almost doubled.

Method of rapid manufacturing of customized orthopedic devices. Process not limited to creating orthopedic devices.

Table 1: roughness with plasma treatment time

<table>
<thead>
<tr>
<th>Treatment Time (s)</th>
<th>R_a (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.668 ± 0.023</td>
</tr>
<tr>
<td>1</td>
<td>0.717 ± 0.0</td>
</tr>
<tr>
<td>5</td>
<td>0.576 ± 0.028</td>
</tr>
<tr>
<td>15</td>
<td>1.059 ± 0.017</td>
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</tbody>
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