MULTI MATERIAL 3D PRINTING

Multi Material 3D printing is quickly becoming a core competency within the additive manufacturing space.

Allowing both an increase in end product capabilities and a decrease in overall end product cost.

Due to the sheer amount of different types of filaments the need to define their many different properties are imperative to their use in a multi material application.
Multi layer additive manufacturing is bringing many capabilities to industries, thermal management is arguably the area which has the greatest opportunity for growth due to this technology. Additive manufacturing not only allows this process to be more economical but often it also allows these improvements more easily and more effective to implement.
PROCEDURE

Test samples were printed at a .2mm resolution following the filament(s) manufacturer recommendations for printing temperature.

Samples were then prepped for the Netzsch Thermal Diffusivity Instrument

Samples were then sliced to view a cross section of their microstructure.
All printing was done at .2mm layer height linear infill, following manufacturer printing recommendations.

Thermal Testing Netzsch LFA 467 HT 25-50C Pyro-Ceram Cp Reference

<table>
<thead>
<tr>
<th>Material</th>
<th>TD 30°C</th>
<th>TD 40°C</th>
<th>TD 50°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural ABS</td>
<td>0.119</td>
<td>0.118</td>
<td>0.116</td>
</tr>
<tr>
<td>White ABS</td>
<td>0.115</td>
<td>0.113</td>
<td>0.111</td>
</tr>
<tr>
<td>Black ABS</td>
<td>0.109</td>
<td>0.109</td>
<td>0.109</td>
</tr>
<tr>
<td>CNT ABS</td>
<td>0.146</td>
<td>0.141</td>
<td>0.136</td>
</tr>
<tr>
<td>Tungsten ABS</td>
<td>0.193</td>
<td>0.186</td>
<td>0.178</td>
</tr>
<tr>
<td>TC Poly Rigid</td>
<td>0.777</td>
<td>0.746</td>
<td>0.725</td>
</tr>
<tr>
<td>TC Poly Flexible</td>
<td>0.240</td>
<td>0.231</td>
<td>0.221</td>
</tr>
</tbody>
</table>
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Unit mm²/s
CHANGE IN SINGLE LAYER STRUCTURE DUE TO THERMAL DIFFUSIVITY TESTING

NATURAL ABS BEFORE TESTING

NATURAL ABS AFTER TESTING
CHANGE IN MULTI LAYER STRUCTURE DUE TO THERMAL DIFFUSIVITY TESTING

NATURAL/WHITE ABS BEFORE TESTING

NATURAL/WHITE ABS AFTER TESTING
OUTCOMES

- Thermal Diffusivity biases toward the lower of the two materials
- Even 'non destructive' methods have an affect on microstructure
FUTURE WORK

- Layer Resolution
- Infill styles
- More Materials
- Differences between Zebra and Half and Half
- Different Printing Technologies
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