VAT Photopolymerization of Smart Structures with Highly Removable and Recyclable Supportable Polymers

Prakash Ghirnikar, Computer Science
Mentor: Xiangjia Li, Assistant Professor
School of Engineering of Matter, Transport and Energy

Background
Current vat photopolymerization (VPP) technology can print three-dimensional (3D) objects with high precision and fast speed [1-2]. For complex computer-aided design (CAD) megastructures, a significant amount of additional support structures is required in order to ensure the overhanging and free-hanging features can be fabricated [3-5]. However, internal support structures cannot be directly removed, and it is time-consuming to manually remove all the support structures. In addition, unexpected damage and undesired surface marks will be caused by the removal of the support structures [6-8]. Although some special materials, such as NaOH-soluble materials and wax, have been utilized to fabricate removable support structures, only certain types of printable material can be used and the removal process brings a lot of waste [6-8].

Principle and method
Multi-material VPP
The multi-material VPP process was used to selectively cure a conventional acrylic-based UV resin and a recyclable thiol-ene photocurable material in a layer-by-layer manner to form high-resolution geometries and complex 3D shapes by using ultraviolet light of 405 nm wavelength. An recyclable thiol-ene resin was used to print supporting structures and acyrate resin was used to print the structures in the same layer.

Result and Discussion
Support dissolve process

<table>
<thead>
<tr>
<th>Grayscale</th>
<th>Left G250</th>
<th>Right G100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure Time</td>
<td>60s</td>
<td></td>
</tr>
<tr>
<td>Layer thickness</td>
<td>200μm</td>
<td></td>
</tr>
<tr>
<td>Resin</td>
<td>40.61%</td>
<td>39.84%</td>
</tr>
</tbody>
</table>

Future work
1) Print more testcases using multi material VPP Process
2) Design support structures to recycle the supports more effectively

Acknowledgement
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