

Lithographic Crystallinity Regulation in Additive Fabrication of Thermoplastics (CRAFT)

Scientific Achievement

A CINT User Team developed a light-based approach for fabricating mechanically robust polyolefin thermoplastics with microscopic control over crystallinity in 3D space.

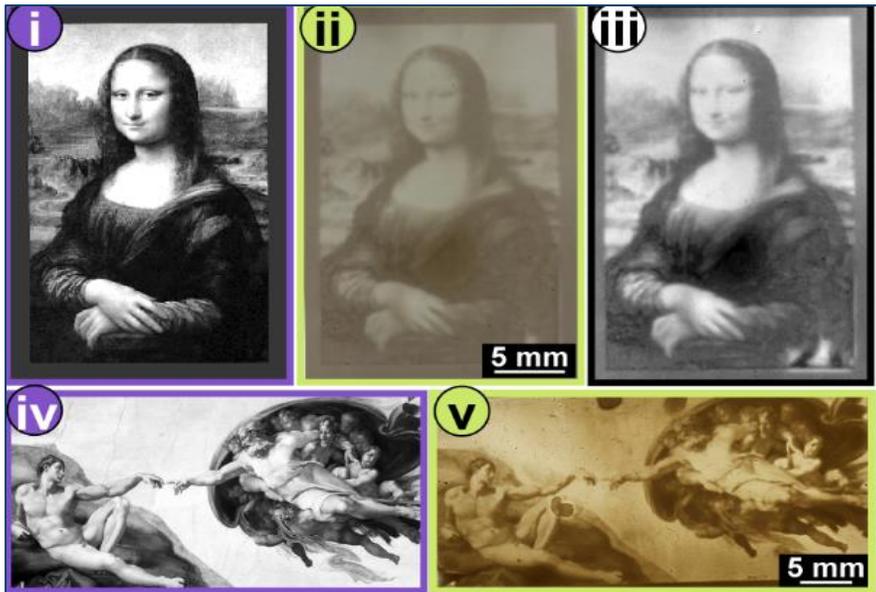


Figure: (i) Grayscale digital image of the Mona Lisa used to print (ii) a pCOE reproduction with spatially varied crystallinity with (iii) a contrast-enhanced grayscale image for analysis. (iv) Grayscale digital image of Michelangelo's *The Creation of Adam* used to print (v) a pCOE reproduction.

Significance and Impact

For semicrystalline thermoplastics, the balance between interconnected ordered crystalline and disordered amorphous regions is paramount to their performance and processability. This work enables 3D fabrication of semicrystalline thermoplastics with access to a continuum of materials, from strong rigid plastics, like high density polyethylene, to more extensible materials akin to low density polyethylene, with voxel-level control.

Research Details

- Initiated photopolymerization through controlled intensity, regulating secondary metathesis to dictate polymer stereochemistry, and crystallinity.
- Enabled rapid lithographic grayscale 3D printing of multi-material objects with voxel-level control over optical and mechanical properties.

Commisso, A. J.; Nagel, E. M.; Kiker, M. T.; Recker, E. A.; Bischoff, A.; Holzmann, M. J.; Fowler, H. E.; Pham, M. N.; Nguyen, C. P.; Baca, E.; Villanueva, H.; Almada, N. T.; Mason, K. S.; Jolowsky, C.; Suman, G.; Fritzsching, K. J.; Kaehr, B.; Schwartz, J. J.; Appelhans, L. N.; Jones, B. H.; Sample, C. S.; Roach, D. J.; Page, Z. A.; Leguizamon, S. C. Lithographic Crystallinity Regulation in Additive Fabrication of Thermoplastics (Craft). *Science*. 2026.

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