Advances in selective laser sintering of polymers

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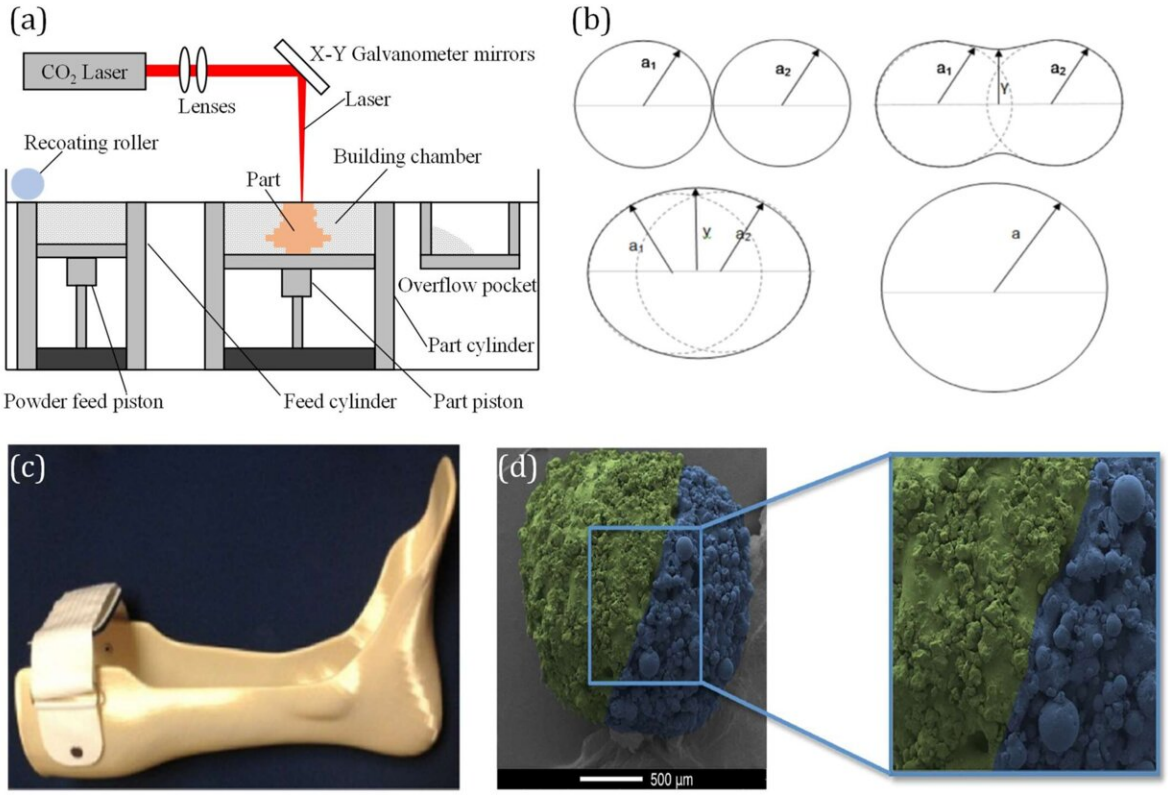

(a) Schematic diagram of the SLS process; (b) Coalescence process of two polymer particles; (c) Ankle-foot orthoses fabricated by additive manufacturing; (d) Dual selective laser sintering minitablets, the yellow regions mean the Ethyl Cellulose regions, whereas the blue regions mean the Kollicoat Instant release regions. Credit: Wei Han, Lingbao Kong, Min Xu.

Researchers at Fudan University, China, reviewed the fundamental mechanisms and recent developments in the selective laser sintering (SLS) of polymers, which is of great help for researchers to learn more about the fantastic additive manufacturing method of polymers. The review is published in the *International Journal of Extreme Manufacturing*.

The binding mechanism of polymers in SLS was introduced based on the Frenkel-Eshelby model when assuming that the particle radius is constant. Further, the typical applications of the SLS polymers parts have been studied, considering the biomedical, pharmaceutical, electronic applications and so on. Finally, future research was summarized based on the above.

"Laser sintering resin is an extremely complex process because of the combination of optics, materials science, chemistry, and thermal disciplines. To obtain parts with superior physical and mechanical properties, it is necessary to deeply understand the sintering mechanism, the influence of process parameters, and the optimization of the sintering process," lead author Professor Wei Han said.

"Laser sintered parts have been widely used in automobiles, medical devices, and daily necessities," said Prof. Lingbao Kong, professor at Shanghai Ultra-Precision Optical Manufacturing Engineering Research Center of Fudan University.

"However, the number of suitable SLS resins has been relatively small for a long time, and there is still a gap between the mechanical properties and density of sintered parts of some special resin materials and the bulk material. Research on new materials, sintering mechanisms, and new application areas still need to be explored further."

Professor Min Xu, director of Shanghai Ultra-Precision Optical

Manufacturing Engineering Research Center of Fudan University, said, "Compared with injection molding, extrusion molding and other methods widely used in the industry, the efficiency of laser sintering polymer is still too low. To widely apply polymer sintering methods in the industry, innovative and efficient new sintering methods require research and attention."

"Polymer particle coalescence mechanism, new SLS polymer, high-speed polymer sintering method, post-processing of sintered polymer, and simulation of sintering process will be the significantly important research in the near future," Professor Han said.

More information: Wei Han, Lingbao Kong and Min Xu, Advances in selective laser sintering of polymers, *International Journal of Extreme Manufacturing* (2022). DOI: 10.1088/2631-7990/ac9096

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