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Abstract

PP Smoothing Process Using Green Solvents

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Novel surface treatment for Additively Manufactured Polypropylene parts is presented in this work. The method uses green sustainable solvents to smooth, seal and remove semi-sintered powder particles from the surface. The surface smoothing produces parts that can be used in medical applications.

Polypropylene (PP) is a non-polar, semi-crystalline thermoplastic polymer belonging to the polyolefin group. PP is the most used thermoplastic, and it is very cost effective as well. The properties of PP are dependent on its crystallinity, molecular weight, and stereochemistry (tacticity). PP has excellent chemical-resistant and water-impermeability properties. The recyclability of PP alongside its properties makes it suitable for many industrial applications [1].

PP finds a lot of relevance in diverse aspects of medicine. It is used in the manufacture of medical products such as syringes, pouches, hospital disposables, test tubes, beakers, and pipettes. Drug-delivery systems, packaging and non-woven fabrics used in hospitals are made from PP. The water-impermeability property of PP makes it an attractive choice in the manufacture of biocompatible implants [2].

One of the main hindrances to the use of 3D-printed PP parts in medical applications is due to the imperfections seen on the printed parts. Solvent smoothing of PP parts is very challenging; owning to the fact that PP is highly resistant to chemicals. However, identified solvents (such as carbon tetrachloride, benzene, xylene, etc.) used to smooth/dissolve PP parts have been identified as carcinogenic, neurotoxic, and environmentally unfriendly [3]. To this end, Additive Manufacturing Technologies Ltd (AMT) using its flagship 3D polymer post-processing equipment and expertise, have successfully demonstrated the smoothing of PP parts using some proprietary green solvents [4, 5]. These green solvents have low toxicities and are environmentally benign.

Our paper reports on the surface treatment/smoothing of 3D-printed PP parts manufactured via selective laser sintering (SLS) by powder; however, the surface treatment/smoothing can also be carried out on PP parts manufactured via multi-jet fusion (MJF). During the post-processing treatment, the green solvents had no chemical interactions with the additives (such as softeners/plasticizers, stabilizers/antioxidants etc.) used in the manufacture of the PP. The smoothed PP parts were seen to have better performance properties, both mechanically and aesthetically. Cytotoxicity results showed that the smoothed PP parts have no cytotoxic effect.

AUTHOR'S STATEMENT

Conflict of interest: C. Nedolisa1 and K. Rybalcenko are employees of Additive Manufacturing Technologies Ltd, Global Research and Innovation Centre, Letsby Avenue, Sheffield, UK, S9 1XU. Acknowledgments: Authors would like to thank Ricoh 3D for providing test samples. Research funding: Additive Manufacturing Technologies Ltd.

REFERENCES

[1] Maddah HA. Polypropylene as a promising plastic a review. American Journal of Polymer Science. 2016; (1):1-11. DOI: 10.5923/ajps.20160601.01
[2] Harutun GK. Handbook of Polypropylene and Polypropylene Composites. 2nd ed. New York: Marcel Dekker; 2009. ISBN: 0-8247-4064-5
[3] https://www.cdc.gov/niosh/topics/organsolv/default.html
[4] Additive Manufacturing Technologies, PostPro Vapor Smoothing Ultrasint ® PP Parts to Unlock New Potentials, Whitepaper, 2021
[5] Additive Manufacturing Technologies, New Process to Smooth Polypropylene 3D printed parts, Whitepaper, 2020

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