“GREENER” STEREOLITHOGRAPHIC RESIN FROM RECYCLED ALUMINA POWDER

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Today there is a growing interest in the use of ceramic enriched materials to manufacture parts that show all the advantages of ceramic elements, like strong dielectric behaviour, high thermal conductivity and stability, and stiffness. Additive manufacturing techniques can be applied as cost effective fabrication technology to reduce at the same time the manufacturing complexity and wastes production. The development of new 3D printable composite materials is a widespread research topic, and the attention is focused on alumina (Al_2O_3) and/or zirconia (ZrO_2) powders as fillers for photocurable resins. In particular, UV curable resins enriched with Al_2O_3 nano- or micro-particles are of great interest [1], [2], due to their relatively easy preparation processes and their wide range of applications in different fields. Moreover, such alumina-enriched resins can be employed to fabricate complex objects with high-resolution additive manufacturing techniques, e.g. stereolithography (SL) 3D printing [3] as in the present work. This promising advanced technique induces polymerization in a photosensible resin, through UV or near UV lasers, with a tens of µm beam spot, speeding up the production processes of ceramic components. The composition of these resins is commonly based on an acrylate monomer, a photoinitiator, a solvent and a dispersant, used for powder suspension stabilization. Al_2O_3 commercially available powders, specifically tailored for resin preparation, are typically hundreds of nm in diameter [4]. The aim of this work is to prepare a UV curable “green” resin for SL enriched with recycled alumina powders instead of fresh ones. Such powders were recovered from sandblasting machines, in order to achieve a concrete example of circular economy. In this study, 60phr Al_2O_3 microparticles (10µm) were incorporated in a PEGDA based resin, eliminating dispersants to increase the environmental sustainability. The so-prepared resin was tested to verify its printability and stability, proving that alumina particles are temporarily stable in suspension, about 4h, assuring the printability of the resin. The alumina powders and the printed samples were also characterized to prove particle surface composition and morphology, and to confirm Al_2O_3 particles loading. Promising results on the final printed parts pave the way for a new method for alumina waste recovery, giving it a second life.

References

[1] J. Zhang, L. Wei, X. Meng, F. Yu, N. Yang, and S. Liu, *Ceram Int*, vol. 46, no. 7, pp. 8745–8753, May 2020

[2] J. J. Relinque, I. Romero-Ocaña, F. J. Navas-Martos, F. J. Delgado, M. Domínguez, and S. I. Molina, *Polymers (Basel)*, vol. 12, no. 8, Aug. 2020

[3] S. S. Ray, H. Dommati, J. C. Wang, and S. S. Chen, *Ceram Int*, vol. 46, no. 8, pp. 12480–12488, Jun. 2020

[4] P. Gonzalez, E. Schwarzer, U. Scheithauer, N. Kooijmans, and T. Moritz, *Journal of Visualized Experiments*, vol. 2019, no. 143, Jan. 2019