

Abstract

Additive Manufactured Polymeric Sandwich Structures for Oral Devices: A Preliminary Study [†]

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Additive manufacturing (AM) techniques have revolutionized the concept of building parts not only in laboratory contexts but also in industry environments and can be applied to distinct fields such as the health, automotive and aeronautics sectors. In fact, contrary to subtractive techniques, AM enables the production of complex geometries using less raw material, within short periods, and with almost no waste. For this reason, it is believed that AM can have a huge impact in manufacturing, being a core element of Industry 4.0. Due to the constant evolution of the industry, new printers are already configured with more than one extrusion nozzle, allowing the printing of more than one material simultaneously.

Considering these advances, the object of the present work was the production and characterization of mono and multi-material sandwich structures prepared by using two different polymeric materials. The outer shells were made of acrylonitrile-butadiene-styrene (ABS), high-impact polystyrene (HIPS) and poly(methyl methacrylate) (PMMA) while, for the core layer, thermoplastic polyurethane (TPU) was kept constant for each sandwich configuration. All materials were chemically and thermally characterized prior to printing. The mechanical properties of mono and multi-material samples were assessed by Transverse Impact Testing and Flexural Testing (Three-Point Bending—3PB). In addition, envisaging application in oral devices, printed specimens were submitted to an aging process.

In summary, it was concluded that the aging step did not negatively affect the mechanical properties of the mono material structures, apart from PMMA. Concerning the sandwich multi-material structures, the flexible TPU core contributed to the softening of the specimen which led to the increase in the resilience of the transverse impact tests. These preliminary results encourage the idea that the prepared printed configurations can be applied in biomedical applications, more particularly in protective oral devices.

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