3D printing of monolithic titania pieces using Pechini resin as organic and inorganic binder

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Additive manufacturing (AM) is relatively new method of fabrication that enables new applications and developments which were harder to achieve through the traditional manufacturing processes. The main challenge for the AM of ceramics resides on the high temperatures needed to melt those materials. Therefore, the extrusion method, called Direct Ink Writing (DIW), has emerged as one of the primary techniques for ceramic AM. The formulation of the ceramic paste for DIW is one of the central aspects of research for this technic [1]. Ceramics can be obtained by polymeric precursor, which consist in the synthesis of a resin with cations on its chains, allowing a great stoichiometric control [2]. Thus, the use of Pechini resin with titanium cations can behave as an organic binder, adjusting the rheology of the ceramic paste, and subsequently as an inorganic binder after heat treatment when combined with P25. The nano titania, which is formed from the resin, has a high surface energy, allowing its sintering at lowers temperatures, aiding in the consolidation of the structure [3]. Samples were printed and heat treated at 350°C. The characterizations through plates rheometer, BET, XRD and SEM indicate the interaction between the P25 and the titania from the resin. The paste present pseudoplastic and thixotropic. BET results show a slight change on the surface area of the material after heat treatment, while the XRD display a noticeable increase of the rutile crystallite without a significant change on phases proportions. The detailed results are still being worked on and will be shared and discussed at the conference.

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