Manufacture of cordierite parts by robocasting from recycled powders

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Advanced ceramics exhibit remarkable properties, such as high mechanical strength, thermal conductivity, or wear resistance. Therefore, they are used as critical components for specific applications in the fields of aerospace, automotive, energy production or cutting tools. Silicate ceramics usually present less efficient properties. However, they can be an economically advantageous alternative to technical ceramics in many applications operating at room or moderate temperature (< 1000°C). Moreover, regarding the environmental aspect, silicate ceramics are processed from natural abundant mineral resources, show a high recyclability, and require moderate sintering temperatures. One potential technical use of silicate ceramics is the manufacture of gas cleaning devices, such as catalyst substrates or particulate filters, as it is the case for the cordierite in the automotive industry. The expansion of the use of these devices in other sectors goes through the development of low costs flexible manufacturing technologies and the improvement of the efficiency of the devices through the design components with complex architectures.

On that purpose, the aim of this study is to demonstrate the possibility to manufacture complex cordierite parts by robocasting. Moreover, this work focuses on the use of an already-formed cordierite powder as raw material, unlike the conventional route which starts from talc, kaolin, and alumina. The target is to pave the way to the use of recycled powders from industrial wastes.

This study deals with the formulation of a stable slurry of cordierite powder with a suitable rheological behavior for the robocasting process and with a sufficient solid content. The effects of 3D printing and sintering parameters on the printed parts regarding their final properties after firing such as density/porosity, expansion coefficient and Young's modulus are also investigated.