DIRECT INK WRITING OF ULTRA HIGH TEMPERATURE CERAMICS

Swetha Chandrasekaran, Materials Science Division, Lawrence Livermore National Laboratory, USA
Chandrasekar2@llnl.gov
Amy Wat, Materials Science Division, Lawrence Livermore National Laboratory, USA
Qi Rong Yang, Materials Science Division, Lawrence Livermore National Laboratory, USA
James T. Cahill, Materials Science Division, Lawrence Livermore National Laboratory, USA
Wyatt Du Frane, Materials Science Division, Lawrence Livermore National Laboratory, USA
Marcus A. Worsley, Materials Science Division, Lawrence Livermore National Laboratory, USA
Joshua Kuntz. Materials Science Division, Lawrence Livermore National Laboratory, USA

Figure 1: Boron carbide/carbon green body printed through direct ink writing.

Additive manufacturing (AM) of engineering materials that are lightweight and durable with excellent chemical and wear resistance continues to be an area of intense interest and study. Fabrication of ultra-high temperature ceramics such as boron carbide (B_4C), zirconium diboride (ZrB_2), hafnium carbide (HfC), Hafnium diboride (HfB_2), zirconium carbide (ZrC) and silicon carbide (SiC) parts through direct ink writing at room temperature has been demonstrated. The 3D printed were made from aqueous, thixotropic ink consisting of the above-mentioned particles with a solid loading ranging from 50.0 to 59.3 vol.%. The complex green bodies (B_4C) are infiltrated with an aluminum matrix to obtain B_4C-Al Cermets. This work describes the process of fabricating such high temperature ceramics-based aerogels through direct ink writing (DIW) technique. 3D printing these ceramic materials could be used to optimize and design the lightweight armor materials or materials used for extreme applications. Complex shaped parts and parts with graded density can be easily fabricated through the DIW technique for molten metal infiltration to create Cermets which are used for ballistic testing devices.

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