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Development of Multilayer Capillary Copper Wick Structure using Microsecond CO_2 Pulsed Laser

Authors : Talha Khan, Surendhar Kumaran, Rajeev Nair

Abstract : The development of economical, efficient, and reliable next-generation thermal and water management systems to provide efficient cooling and water management technologies is being pursued application in compact and lightweight spacecraft. The elimination of liquid-vapor phase change-based thermal and water management systems is being done due to issues with the reliability and robustness of this technology. To achieve the motive of implementing the principle of using an innovative evaporator and condenser design utilizing bimodal wicks manufactured using a microsecond pulsed CO_2 laser has been proposed in this study. Cylin drical, multilayered capillary copper wicks with a substrate diameter of 39 mm are additively manufactured using a pulsed laser. The copper particles used for layer-by-layer addition on the substrate measure in a diameter range of 225 to 450 micrometers. The primary objective is to develop a novel, high-quality, fast turnaround, laser-based additive manufacturing process that will eliminate the current technical challenges involved with the traditional manufacturing processes for nano/micro-sized powders, like particle agglomeration. Raster-scanned, pulsed-laser sintering process has been developed to manufacture 3D wicks with controlled porosity and permeability.

Keywords : liquid-vapor phase change, bimodal wicks, multilayered, capillary, raster-scanned, porosity, permeability
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