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Direct Ceramic Forming by Lithographic Additive Manufacturing

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Abstract

 $\mathbf{N}_{\mathrm{ewly}}$ developed Ultraviolet laser lithography can directly form fine ceramic components with micro geometric patterns. As an additive manufacturing technique, two dimensional cross sections were created through dewaxing and sintering by UV laser drawing on spread resin paste including ceramic nanoparticles, and three dimensional composite models were sterically printed by layer laminations and interlayer joining. Nanoparticles of alumina, titania or calcium phosphate of 300 nm in average diameter were dispersed in to photo sensitive liquid resins at 50 % in volume fraction. The resin paste was spread on a glass substrate at 50 µm in layer thickness by a mechanically moved knife edge. An ultraviolet laser beam of 355 nm in wavelength was adjusted at 10 µm in diameter and scanned on the surface. Irradiation power was increased to 1.0 W for enough solidification depth. The half wavelength of the incident ultraviolet ray should be comparable with the nanoparticles gaps in the resin paste, and electromagnetic field can be resonated and concentrated through Anderson localization. After the layer lamination, the ceramic structures at 99 % in sintering density were successfully processed to create the alumina thermoacoustic stacks, the titania electromagnetic devices and the calcium phosphate biological implants.



Biography:

Soshu Kirihara is a doctor of engineering and a professor of Joining and Welding Research Institute (JWRI), Osaka University, Japan. In his main investigation Materials Tectonics for environmental improvements as Geotechnology, multidimensional structures were successfully fabricated to modulate energy and materials flows effectively. Ceramic and metal components were fabricated directly by Smart Additive Manufacturing, Design and Evaluation (Smart MADE) using power ultraviolet laser lithography. Original high stereolithography systems were developed, and new start-up company SK-Fine was established through academic-industrial collaboration.

Speaker Publications:

- 1. Direct Additive Manufacturing of Fine Ceramic Components by Laser Lithography, Soshu Kirihara, Ceramics Japan, 55, 2 (2020) 1-4., 2020.02, Review Papers(In Japanese)
- Stereolithographic Additive Manufacturing of Ceramic Components with Micropatterns for Electromagnetic Wave Control, Soshu Kirihara, Ceramics in Modern Technologies, 1, 2 (2019) 84-90., 2019.08, Papers
- Structural Dimension Control in Smart Additive Manufacturing, Soshu Kirihara, Journal of Smart Processing - for Materials, Environment & Energy -, 8, 4 (2019) 124-131., 2019.07, Review Papers(In Japanese)
- Fabrication of Alumina Microlattice Structures by Using Ultraviolet Laser Lithography, Koki Nonaka, Soshu Kirihara, Journal of Smart Processing - for Materials, Environment & Energy -, 8, 4 (2019) 147-150., 2019.07, Papers(In Japanese)

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