



Additive Manufacturing of Ceramic Components

Soshu Kirihara

Osaka University, Japan

Abstract:

Dielectric ceramic components with micro lattice patterns were successfully fabricated by newly developed ultraviolet laser lithography. As an additive manufacturing, 2D cross sections were created through dewaxing and sintering by UV laser drawing on spread resin paste including ceramic nanoparticles, and 3D composite models were sterically printed by layer laminations [1-3]. As the raw material of the lithography, ceramic nanoparticles from 500 nm in average diameters were dispersed in to photo sensitive liquid resins from 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 spot diameter and scanned on the pasted resin surface. Irradiation power was changed from 600 to 700 mW to obtain the enough solidification depth for 2D layer bonding. Scanning speed was changed from 50 to 100 mm/s to create fine lattice structures. The half wavelength of incident ultraviolet ray should be comparable with the nanoparticles gaps in the resin paste, therefore the dewaxing and sintering will be realized through the electro-magnetic waves resonations and localizations. Through the layer lamination, the 3D titania structures with 97% in volume fraction were fabricated as shown in the following image. The titania crystal structure was analyzed as dual phase of anatase and rutile. After the heat treatment at 1350 $^{\circ}\text{C}$ for 2 hs in the air atmosphere, titania components with rutile phase was obtained.

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", geo-



metric structures were successfully fabricated to modulate energy and materials flows effectively. Ceramic components were fabricated directly by stereolithographic additive manufacturing using high power ultraviolet laser. Original stereolithography systems were developed, and new start-up company "SK-Fine" was established through academic-industrial collaboration.

Publication of speakers:

- Three-dimensional microphotonic crystals of ZrO_2 toughened Al_2O_3 for terahertz wave applications, W. Chen, S.Kirihara, Y. Miyamoto, Applied Physics Letters, 91 (2007) 153507-1-1535073.
- of Electromagnetic Response of 3-D Dielectric Fractals of Menger Sponge Type, E. Semouchkina, Y. Miyamoto, S. Kirihara, G. Semouchkina, M. Lanagan, IEEE Transactions on Microwave Theory and Techniques, 55(6) (2007) 1305-1313. Materials Engineering and Nanotechnology Conference, November 25-26,2020, Singapore City, Singapore

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