Received date: 31-05-2022 | Accepted Date: 01-06-2022 | Published Date: 05-09-2022

Stereolithographic additive manufacturing of ceramic dental crowns

Soshu Kirihara and **Osaka**
University, Japan

In stereolithographic additive manufacturing (STL-AM), 2-D cross sections were created through photo polymerization by UV laser drawing on spread resin paste including nanoparticles, and 3-D models were sterically printed by layer lamination. The lithography system has been developed to obtain bulky ceramic components with functional geometries. An automatic collimeter was newly equipped with the laser scanner to adjust the beam diameter. Fine or coarse beams could realize high resolution or wide area drawings, respectively. As the row material of the 3-D printing, nanometer sized metal and ceramic particles were dispersed into acrylic liquid resins at about 60 % in volume fraction. These materials were mixed and deformed to obtain thixotropic slurry. The resin paste was spread on a glass substrate with 50 μm in layer thickness by a mechanically moved knife edge. An ultraviolet laser beam of 355 nm in wavelength was adjusted to 50 μm in variable diameter and scanned on the spread resin surface. Irradiation power was automatically changed for an adequate solidification depth for layer bonding. The composite precursors including nanoparticles were dewaxed and sintered in the air atmosphere. In recent investigations, ultraviolet laser lithographic additive manufacturing (UVL-AM) was newly developed as a direct forming process of fine metal or ceramic components. As an additive manufacturing technique, 2-D cross sections were created through dewaxing and sintering by UV laser drawing, and 3-D components were sterically printed by layer laminations with interlayer joining. Recently, zirconia dental crowns with fine microstructures were fabricated by lithographic AM. Through computer-aided smart manufacturing, design, and evaluation (Smart MADE), practical material components were fabricated to modulate energy and material transfers in potential fields between human societies and natural environments as active contributions to Sustainable Development Goals (SDGs).

References:

1. Soshu Kirihara, Systematic Compounding of Ceramic Pastes in Stereolithographic Additive Manufacturing, Materials, 14 [22] (2021) 1895611-1895945.

2. Soshu Kirihara, Stereolithographic Additive Manufacturing of Acoustic Devices with Spatially Modulated Cavities, International Journal of Applied Ceramic Technology, (2021) 13925-1-13925-8.

3. Masaya Takahash, Soshu Kirihara, Stereolithographic Additive Manufacturing of Zirconia Electrodes with Dendritic Patterns for Aluminum Smelting, Applied Sciences, 11 [17] (2021) 8168.

4. Soshu Kirihara, Stereolithographic Additive Manufacturing of Ceramic Components with Functionally Modulated Structures, Open Ceramics, 5 [100068] (2021) 1-8.

5. Soshu Kirihara, Ultraviolet Laser Lithography of Titania Photonic Crystals for Terahertz-Wave Modulation, Materials, 11 [5] (2018) 835-845.

6. Koki Nonaka, Soshu Kirihara, Three Dimensional Smart Processing by Ultra Violet Laser Lithography of Ceramic Additive Manufacturing, Journal of Materials Science Forum, 941 (2018) 2196-2199.

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 as Sustainable Geoengineering” for environmental modifications and resource circulations, multi-dimensional 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 high power ultraviolet laser lithography. Original stereolithography systems were developed and new start-up company “SK-Fine” was established through academic-industrial collaboration.

kirihara@jwri.osaka-u.ac.jp