ADA Science & Research Institute

3D Printing of Composition-Controlled Copolymers

ADASRI Case # 16-0002

Inventors

Jirun Sun (ADA)

Young Lee (NIST)

Background

3D printing (or additive manufacturing) has emerged as a versatile platform for computer-assisted design and rapid prototyping. Many polymeric materials may be used in printing, producing complex-shaped structures with specific compositions, where the mechanical properties may be varied according to the printing process. To produce structures made from multiple materials, multiple printing heads need to be used. In some applications, it is desirable to produce materials with a graded composition throughout the structure, without the complexity of having to use multiple printing heads.

Invention Description

ADA and NIST inventors have developed a computer-controlled method for forming composition-controlled 3D printed structures. Two or more liquid reactants may be mixed at varying mass ratios, and then deposited onto a substrate where they are polymerized using a light source. By varying the mass ratios of the reactants, the mechanical, chemical, physical and biological properties of the printed product can be controlled, and these properties can be continuously or discretely controlled throughout a complex 3D printed structure. As one example, a mixture of triethylene glycol-divinylbenzyl ether (TEG-DVBE) and urethane dimethacrylate (UDMA) can produce structures with a varying refractive index across the structure. The method also allows for the inclusion of additives such as nanoparticles, to further tailor the properties of the 3D printed structures.

Intellectual Property Status:

US Patent Issued:
US 10,625,470 B2

Potential Applications

The method of the present invention can be used to produce materials and structures for use as

- Medical devices such as dental implants, dentures, veneers, catheters, hearing aids, and medical filters,
- Optical devices such as graded-index (GRIN) lenses and optical coatings such as anti-reflection coatings

Benefits and Advantages

- A single printing process with only on printing head required
- Precise compositional control throughout a printed structure
- Compositionally-dependent mechanical, chemical, physical and biological properties can be tailored to specific applications
- Method allows the addition of solid dispersion components into the liquid mixture for specific applications (e.g. filler nanoparticles for dental materials)

Contact

Phil Dowd

Director of Innovation

American Dental Association Science & Research Institute

Email: dowdp@ada.org