The Summer Undergraduate Research Fellowship (SURF) Symposium
2 August 2018
Purdue University, West Lafayette, Indiana, USA

Investigation of ITX Derivative Photoinitiators for Depletion Lithography

Ran Le, Paul Somers, Liang Pan and Xianfan Xu
School of Mechanical Engineering, Purdue University
Teng Chi and Bryan Boudouris
School of Chemical Engineering, Purdue University

ABSTRACT

Direct laser writing (DLW) with two-photon polymerization (TPP) allows for fabricating 3-dimensional nano-scale polymer structures by focusing an ultrafast laser inside a photoresist system consisting of a monomer and photoinitiator. The photoinitiator is excited by the laser and triggers the polymerization process of the monomer. Stimulated emission depletion (STED), which was designed for resolution enhancement for microscopy, could be applied to this process and inhibit the polymerization with an additional laser for depletion. This STED process can be used to increase the resolution of the 3D printing. However, the photoresist for STED-DLW should contain a photoinitiator that is sensitive to both the writing laser and the depleting laser, and very few initiators currently exist which meet these strict requirements. Previous studies on 7-diethylamino-3-thenoylcoumarin (DETC) and isopropyl thioxanthone (ITX) have revealed their initiation and depletion capabilities. However, some derivatives of ITX also have the potential to be used as STED inspired photoinitiators. The behaviors of these derivatives are tested by varying the power of both the writing and depleting lasers and the writing speed. Comparisons are made between the different photoresist systems by investigating the writing and depletion thresholds as well as printed structure quality. Results show that ITX derivatives have good writing performance at low writing power, but they have poor response to the depletion laser.

KEYWORDS

Direct laser writing, stimulated emission depletion, two-photon polymerization, 3D printing