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Additive Manufacturing of Active Medical Devices

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Abstract:

Two photon polymerization is a 3D printing approach that relies on the use of ultrashort laser pulses to selectively polymerize and solidify photosensitive materials. The quadratic character of the two photon absorption probability and the well-defined polymerization threshold of this approach allow one to overcome the diffraction limit and obtain structures containing features below one micrometer. Two photon polymerization has recently been to prepare several classes of microstructured and nanostructured medical devices out of biocompatible inorganic-organic hybrid materials (e.g., zirconium oxide hybrid materials) and polymers for medical applications. The use of biocompatible and biobased photoinitiators (e.g., a combination of riboflavin and triethanolamine) for two photon polymerization will be described. Integration of electrochemical sensors with two photon polymerization-processed devices will be considered. Evaluation of two photon polymerization-processed materials using _in vitro_ biological studies will be described. In addition, application-specific studies of two photon polymerization-processed medical devices for biosensing, drug delivery, and tissue engineering will be discussed. Our results show that two photon polymerization provides unique benefits for processing medical devices with small-scale features and unique medical functionalities.