Two-photon microfabrication of structures containing the biopolymer Chitosan

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# Outline

Two-photon polymerization Sample preparation Experimental setup Results on the fabrication of the microstructures Conclusion

## Two-photon polymerization



2PA: simultaneous absorption of two photons far from a material's linear absorption region.

 $R_{2PA} \propto I^2$ 

The absorption is confined to the focal volume.

High spatial resolution



#### Microstructures fabricated by two-photon polymerization











### Applications of two-photon polymerization

#### **Optics and Photonics**

Doping microstructures with organic molecules and metals

fluorescence birefringence conductivity

#### **Bio-applications**

Fabrication using bio-compatible resins to biological applications

tissue engineering scaffolds fabrication of microneedle cell study

### Chitosan



linear cationic polysaccharide obtained by deacetylation of chitin, which is normally found in crustaceans.

#### **Applications**

biodegradability biocompatibility bone regeneration drug-delivery bactericide action blood coagulation

#### **Resin Preparation**

#### Monomers

**SR499** 



**SR368** 



reduces the shrinkage upon polymerization

gives hardness to the polymeric structure

#### Photoinitiator



### Resin preparation

- ethanol solutions containing SR368 (70%), SR499 (30%) and chitosan (1-20% by weight)
- ethanol is eliminated by evaporation at room temperature for 24 h
- add the photoinitiator (1% by weight) one hour before use

### Two-photon polymerization setup



### Two-photon polymerization





After fabrication, the sample is immersed in ethanol to wash away any unsolidified resin and then dried



30 µm x 30 µm x 12 µm cube

#### SEM of microstructures containing chitosan





#### Microstructures show excellent integrity and good definition

#### Hardness measurements



#### Raman Spectroscopy



 $\lambda_{exc}$  = 514 nm

### Conclusion

We demonstrated the fabrication of microstructures containing chitosan via two-photon absorption polymerization.

The microstructures present integrity and good definition, allowing applications in bio-related fields.

#### Current work

IR absorption of the microstructures Two-photon absorption spectrum of Chitosan Cell growth studies (fibroblast)

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