

# Biocompatible microstructures fabricated by two-photon absorption polymerization

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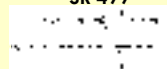
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Two-photon absorption (2PA) polymerization is a powerful tool for fabricating three-dimensional microstructures for applications ranging from photonics to biology. To tailor such microstructure for specific purposes it is often important to dope them. Here we report on the fabrication of microstructures using 2PA polymerization of an acrylic resin doped with the biocompatible polymer chitosan using a guest-host scheme. The approach presented in this work can be used in the fabrication of microstructures containing biopolymers for biomedical applications.

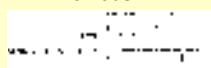
## • Host acrylic resins

### SR 499



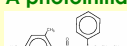
Decreases residual stress upon shrinkage

### SR 368



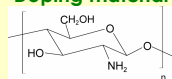
Provides hardness to the polymerized resin

## • 2PA photoinitiator



Lucirin TPO-L

## • Doping material

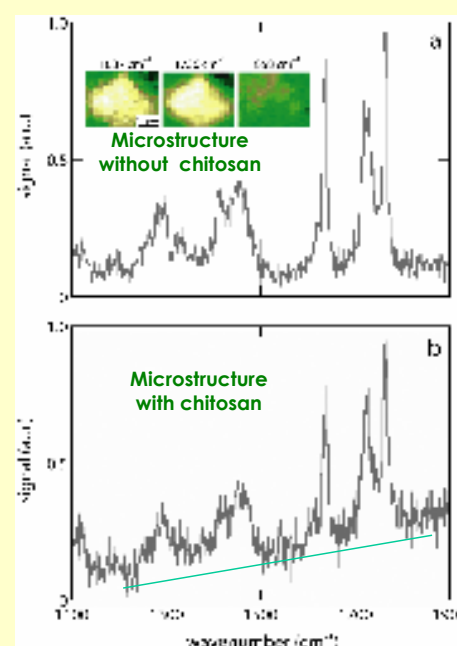
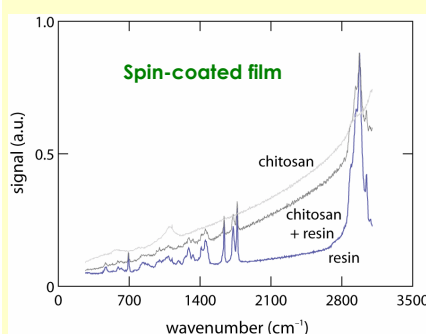


Chitosan

## • Applications

- blood coagulation
- tissue and bone regeneration
- bacterial action

## • Raman spectrum of films and of microstructures having the same chemical composition



## • Hardness Shore D measurement test

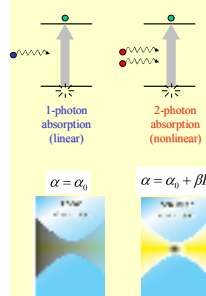
Material	Hardness (shore D scale)
resin	80±1
resin + chitosan	80±1
nylon	80±1
polystyrene	74±1
polypropylene	68±1

The Raman spectrum of films or microstructures with chitosan differs from that of films or microstructures made without chitosan only in a fluorescence background attributed to chitosan. Because the addition of chitosan only does not affect the vibrational Raman spectrum of the resin, we infer that crosslinking or other chemical interaction between the acrylic resin and the chitosan is negligible. Such mixing without chemical interaction is desirable for biomedical applications, because it implies that the acrylic resins retain the chitosan without altering any of its biological or chemical properties. Besides, our mechanical test results indicate that chitosan does not reduce the hardness of the acrylic resins and present a hardness value comparable to other commercial polymers.

## ✓ Conclusions

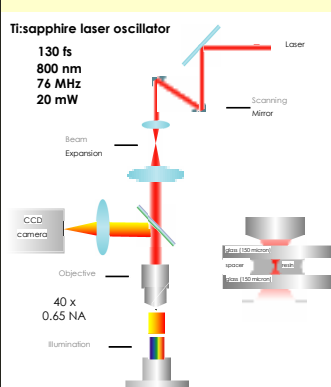
We present a novel approach for fabricating microstructures containing the biocompatible polymer chitosan via two-photon absorption polymerization. The microstructures present good definition and structural integrity. Raman measurements show that chitosan is incorporated in the microstructure and is distributed throughout the bulk of the microstructure. The spectra also show that chitosan does not react chemically with the acrylic resin, which is a required condition for biomedical applications. Finally, hardness measurements show that chitosan does not impair the mechanical properties of the resins. Therefore, fabrication of microstructures containing chitosan via 2PA polymerization is suited for biomedical applications.

## Two-photon absorption (2PA)

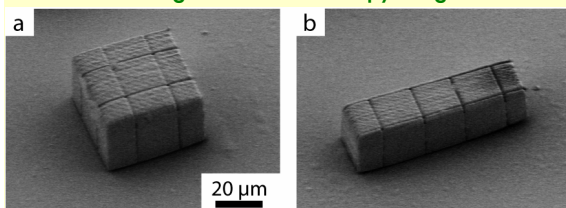


Due to the nonlinear nature of the 2PA process, photopolymerization occurs only at the tiny focal spot, allowing the fabrication of sophisticated microstructures

## • 2PA polymerization experimental setup



## • Scanning electron microscopy images



The chitosan-containing microstructures displayed excellent integrity and good definition, indicating that the presence of chitosan does not affect the fabrication process and confirming the feasibility of fabricating chitosan-containing microstructures by two-photon absorption polymerization.