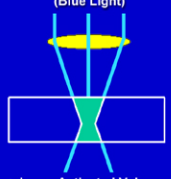
Air Force Basic Research
Biomimetics - Microfabrication
AFRL/MLPJ & AFOSR/NL

Ultrafast Holographic Two-Photon Induced Polymerization (H-TPIP)

- *The development of the H-TPIP technique has opened new technological areas for the AF and science in general, e.g., advanced optical coatings*
- *Advantages that only a two-photon process possesses*

One-Photon Focused Beam

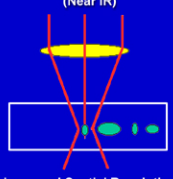
λ~400NM (Blue Light)



- Large Activated Volume
- Single Site
- Poor Penetration Depth

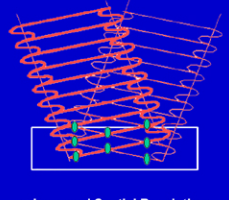
Two-Photon Focused Beam

λ~800NM (Near IR)



- Improved Spatial Resolution (due to intensity threshold)
- Single Site
- Better Penetration Depth

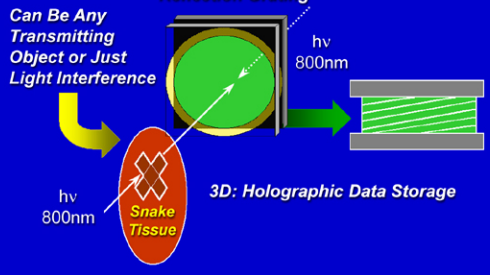
Two-Photon Holography



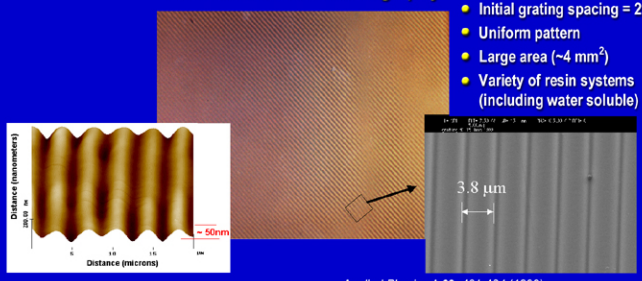
- Improved Spatial Resolution (due to intensity threshold)
- Multiple Site (Parallel Process)
- Better Penetration Depth

Reflection Grating

Fresnel Counter-Propagating Holographic Reflection Grating



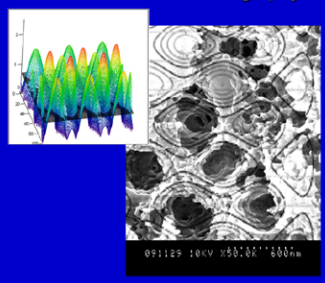
Two-Beam Ultrafast Holography



- Initial grating spacing = 2.9 μm
- Uniform pattern
- Large area (~4 mm^2)
- Variety of resin systems (including water soluble)

Applied Physics A **69**: 461-464 (1999)

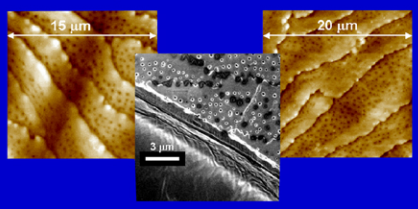
Three-Beam Ultrafast Holography



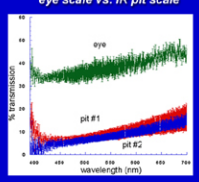
Biological Applications

Surface Replication

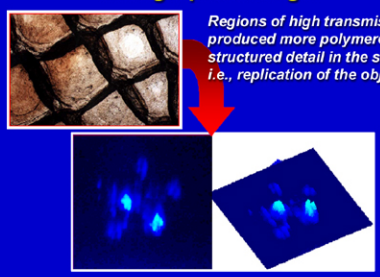
- *Morphologically unique*
- *Visible light scattering*
- *First Scanning probe microscopy or 3D picture of a biological IR sensor Surface*



Percent transmission for shed pit viper eye scale vs. IR pit scale



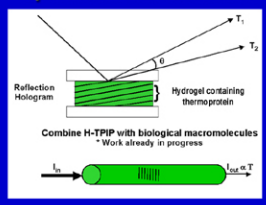
Snake Scale & Corresponding Holographic Image



Regions of high transmission produced more polymereic structured detail in the sample, i.e., replication of the object.

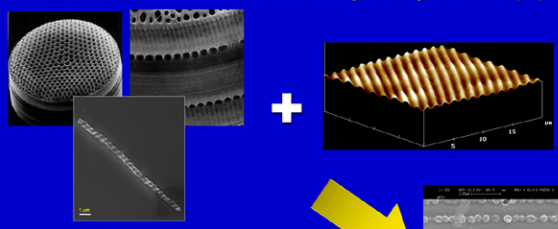
Biomimetic Devices

Optical Thermal Sensor



Diatoms: Potential of Nano-Biotechnology

- *Biomimetic synthesis of ordered silica structures mediated by proteins*
- *Enhanced microfabricated structures due to combined organic/inorganic materials properties*



Hybrid organic/inorganic gratings with increased efficiency due to larger index of refraction mismatch

- *Not limited to optical structures, possibilities include microfluidics*