Photonics research Overview
Colorado State University

Mario Marconi

Colorado State Unversity
Electrical and Computer Engineering
NSF Engineering Research Center for
Extreme Ultraviolet Science and Technology

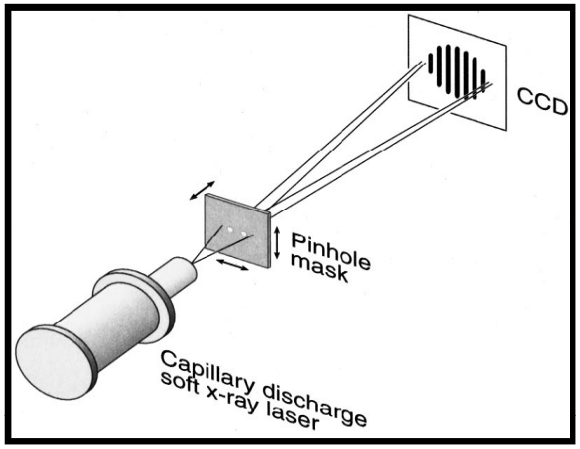
Compact table top EUV laser sources

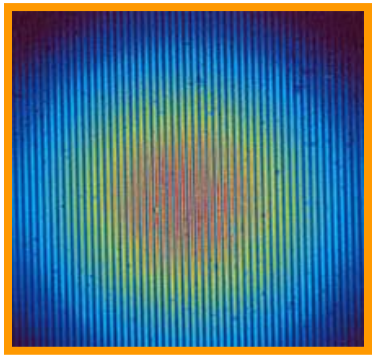
J.J. Rocca

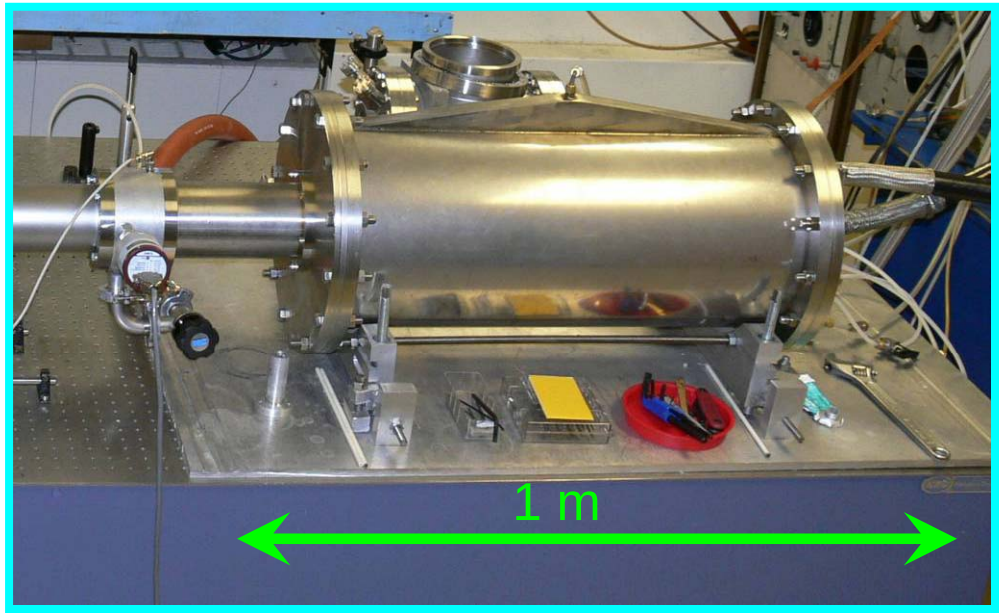
Discharge pumped EUV lasers:

Advantages:

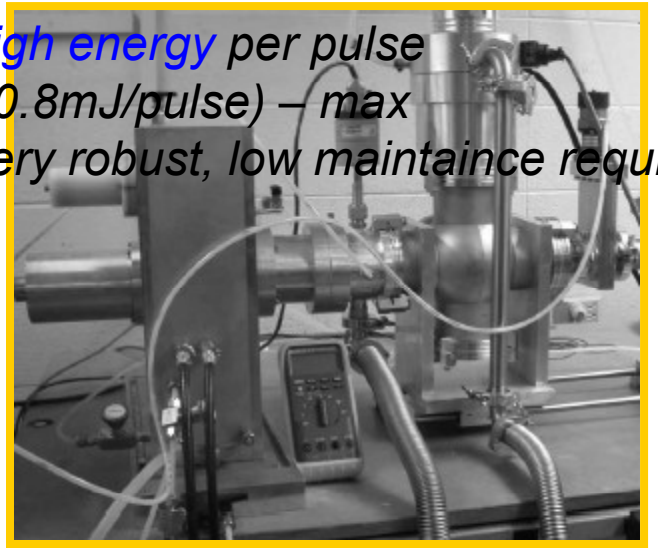
- *lasers – so are highly coherent (spatial and temporal) – good for specific applications*
- *small – table-top or even desk-top*







- *high energy per pulse (~0.8mJ/pulse) – max*
- *very robust, low maintaince required,*

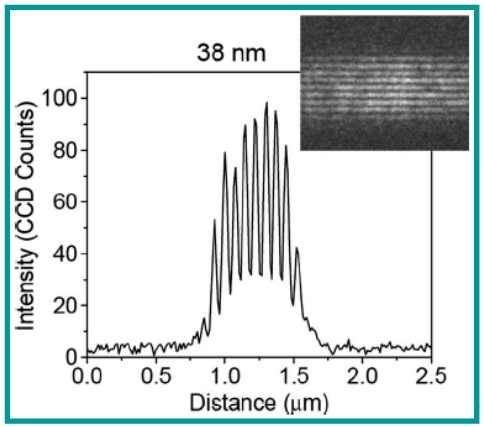


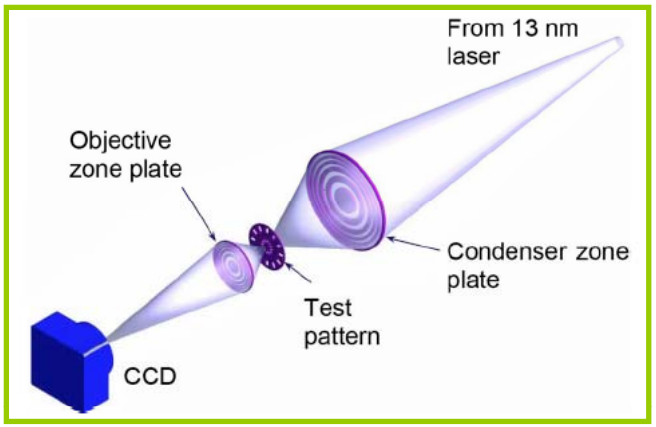
November 16, 2007

Applications
C.S. Menoni, J.J. Rocca, M.C. Marconi

- **EUV Microscopy**

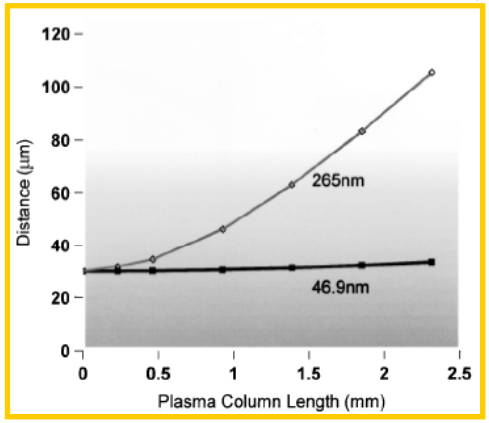
38nm resolution with 13.2nm Cd laser, ~70% modulation

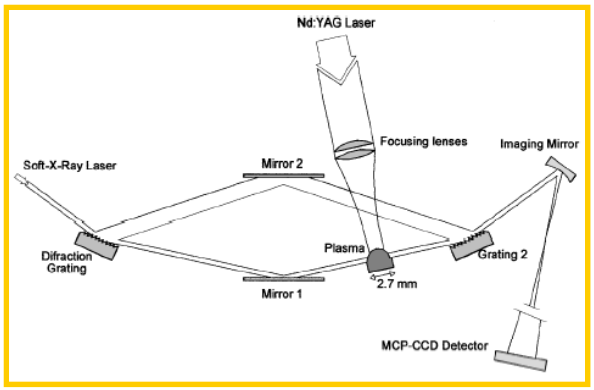




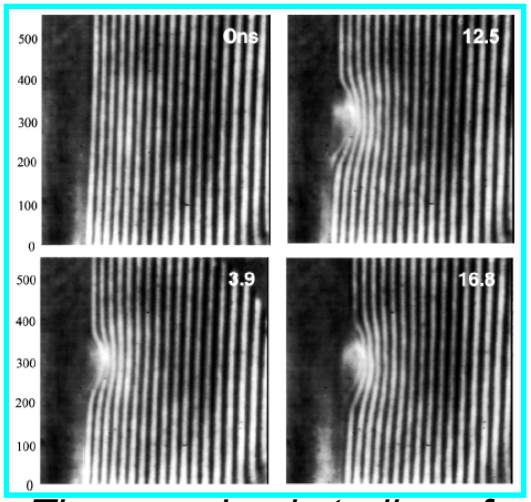
"Sub-38 nm resolution tabletop microscopy with 13 nm wavelength laser light" Vaschenko at. al., OPTICS LETTERS / Vol. 31, No. 9 / May 1, 2006

- EUV Interferometry of dense plasmas





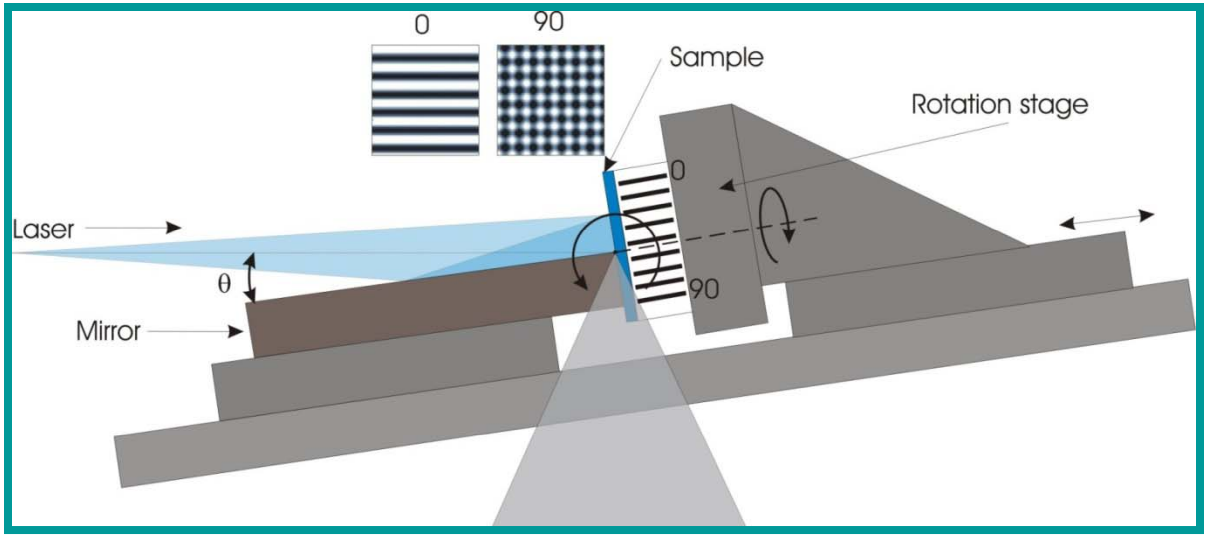
"Dense plasma diagnostics with an amplitude-division soft-x-ray laser interferometer based on diffraction gratings", J. Filevich, et. al., OPTICS LETTERS / Vol. 25, No. 5 / March 1, 2000



Time resolved studies of dense plasmas

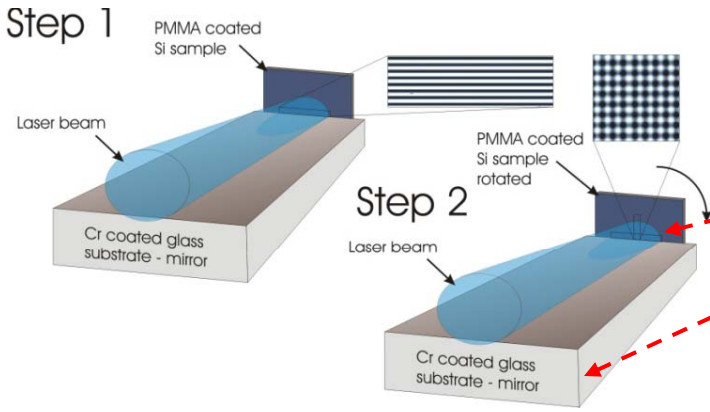
Table top tool for nano- photolithography

M. Marconi



Double exposure set up with a Lloyd's mirror

Two successive exposures allows printing arrays of nanometer size features



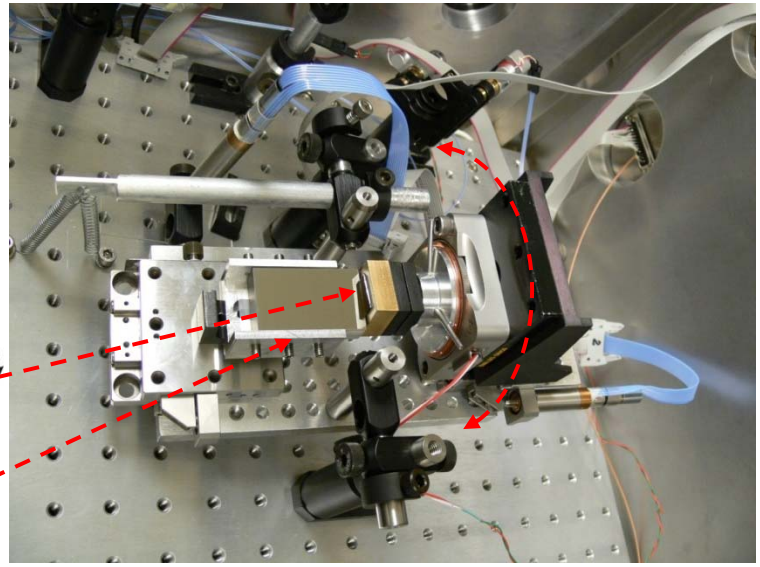


Table top tool for nano- photolithography

M. Marconi

46.9-nm Capillary Discharge Laser : the most powerful source at this wavelength in the World

Printing in PMMA

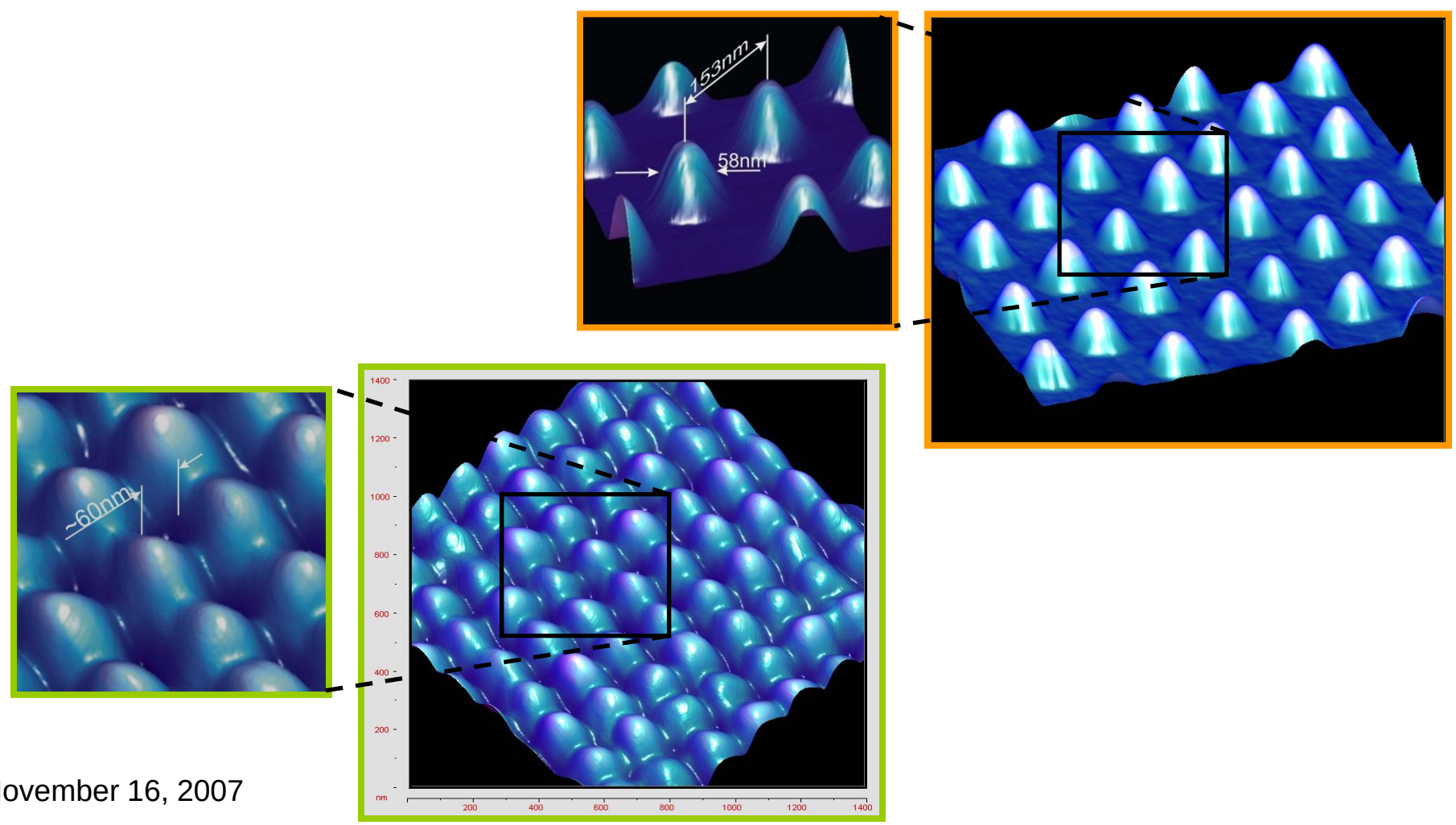
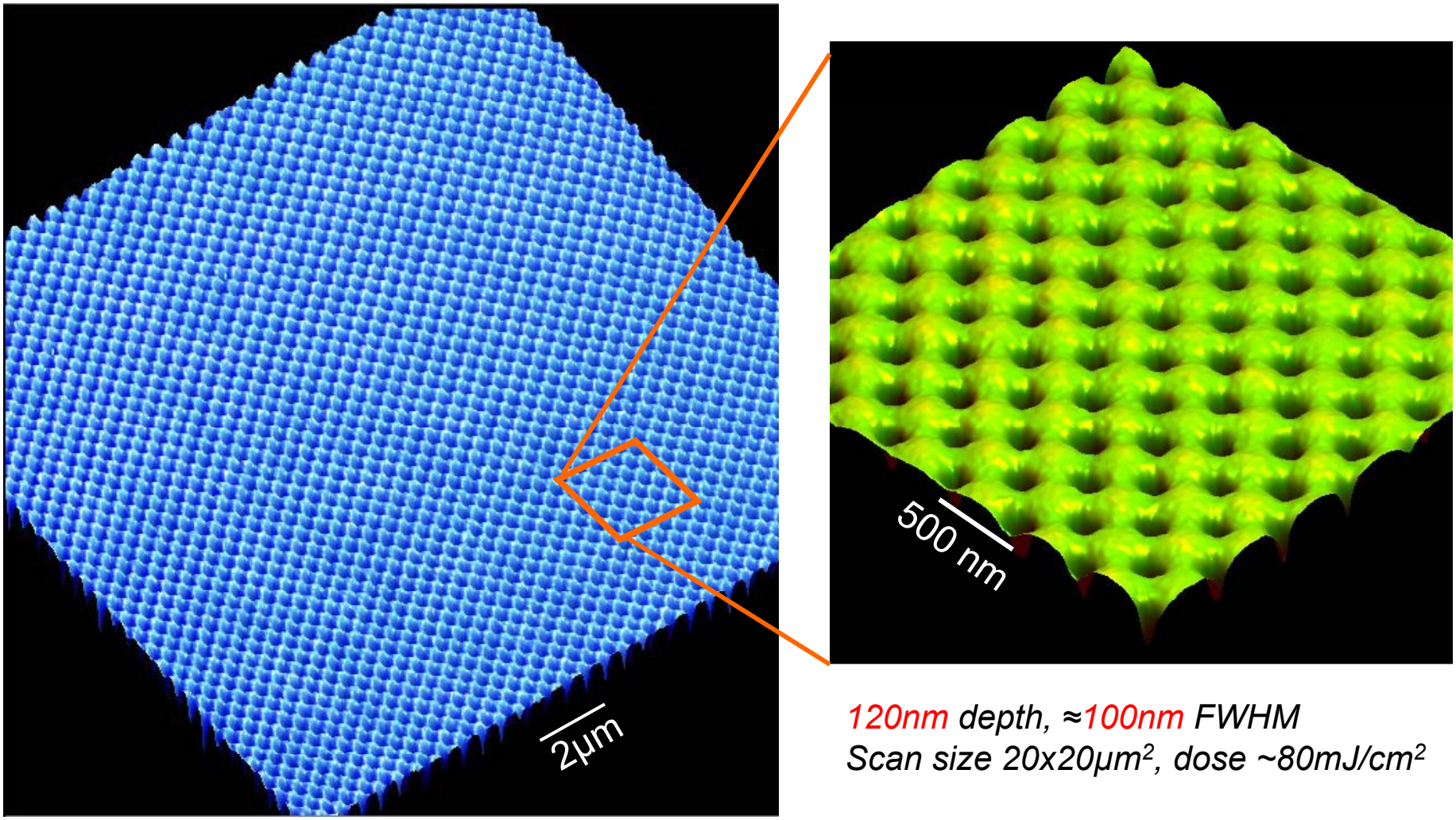


Table top tool for nano- photolithography

M. Marconi

Colorado State University

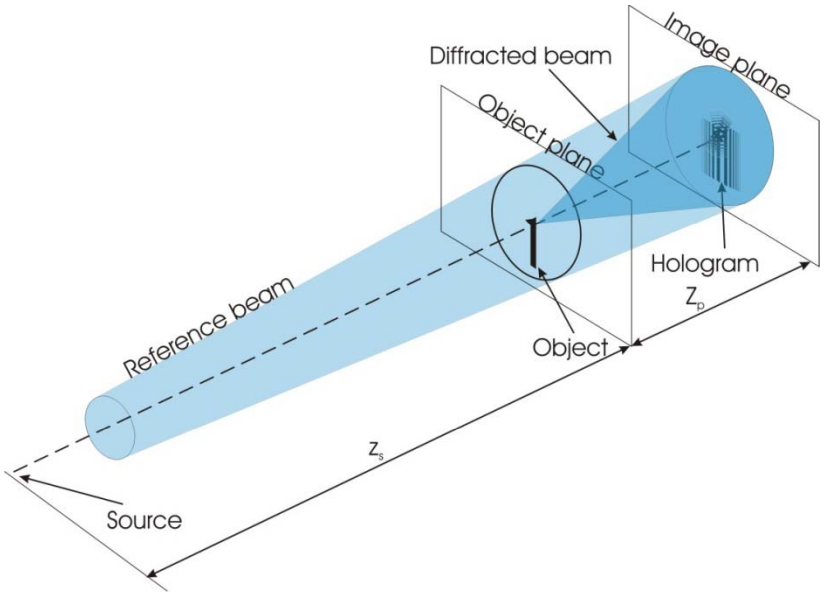
Printing in HSQ

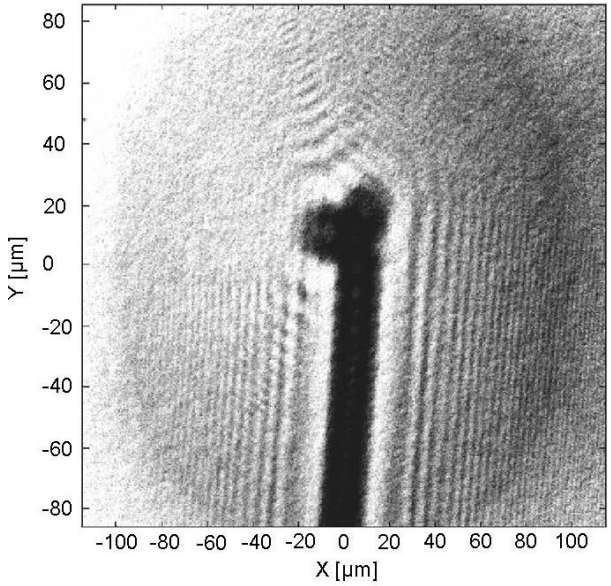


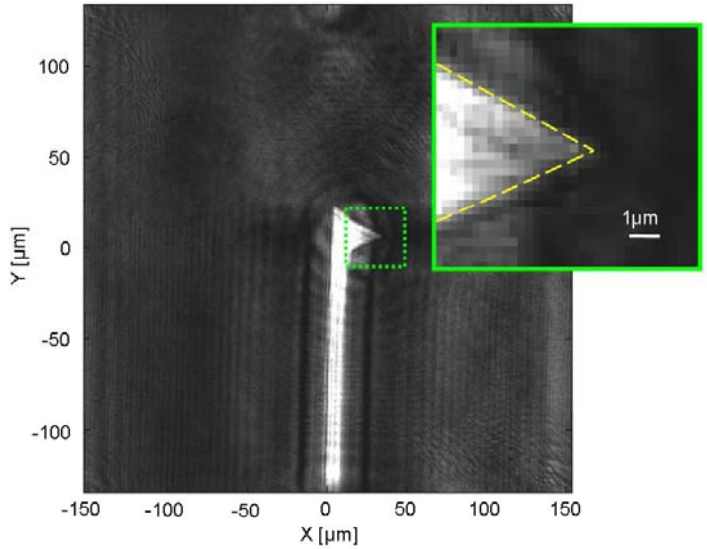
120nm depth, ≈100nm FWHM
Scan size 20x20μm², dose ~80mJ/cm²

EUV holography

M. Marconi, R Bartels, C.S. Menoni



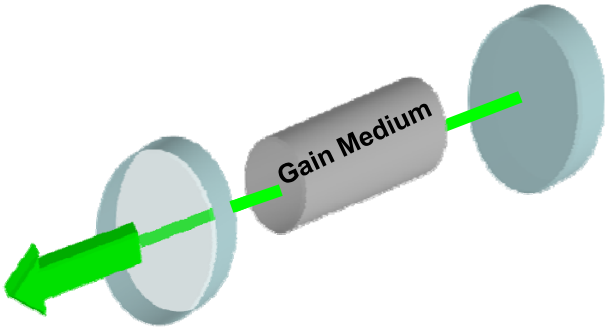




Advanced interference coatings for High Energy Lasers

C. S. Menoni

Goal: to understand material science and optical properties of oxide materials to engineer low loss interference coatings for high energy lasers



Power extraction in High Energy Lasers is limited by robustness of the optics

Method: Ion Beam Sputtered Deposition yield coatings with the highest density of all deposition methods and most robust in terms of temperature and environment stability

Repertoire of diagnostics techniques
- Stress
- Cavity ringdown for total loss
- Pulsed LIDT
- X-Ray Diffraction and composition
- Surface roughness

Results on HfO2/SiO2 stacks
- Single pulse LIDT of stacks is >3.0 J/cm^2
- HfO2/SiO2 stacks withstand Irradiances >200KW/cm^2

Applications: Near Infrared Free Electron Lasers, Tera and Peta Watt lasers

New Faculty at CSU-ECE

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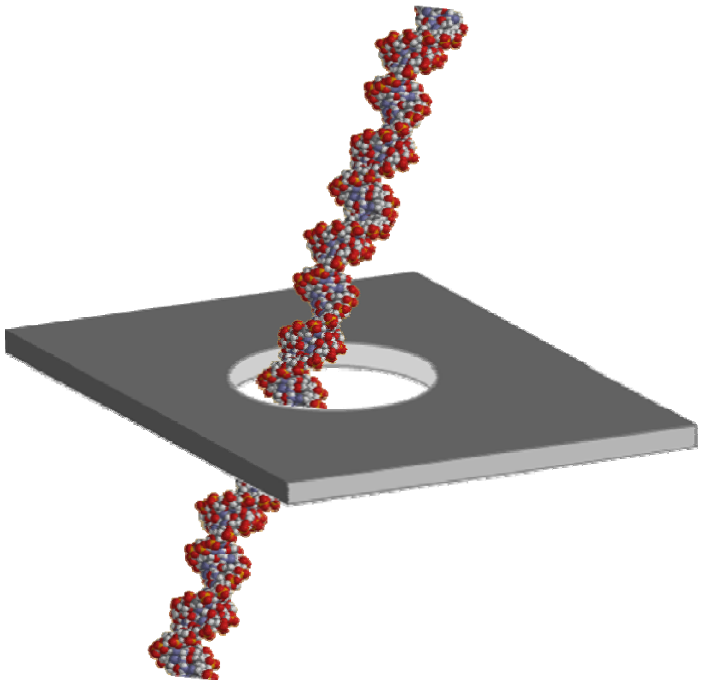

Single-molecule biophysics experiments at the nanometer scale.
Techniques: novel nanoscale devices such as solid-state nanopores, imaging tools for single-molecule tracking, and nanomanipulation instruments like optical tweezers.
Protein-DNA interactions, understanding nucleosome dynamics, and developing a nanotechnology platform for high-throughput DNA sequencing.