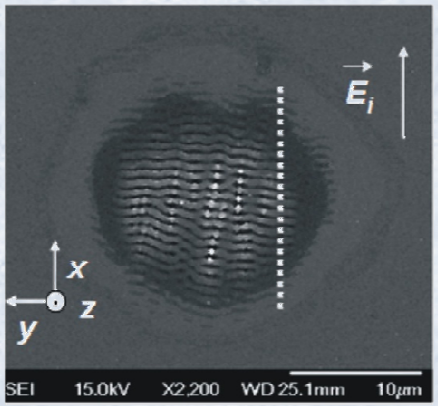
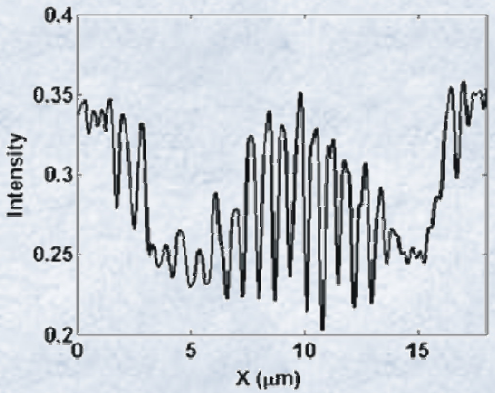
Foundation for Research & Technology – Hellas (FORTH)
Institute of Electronic Structure & Laser (IESL)

Surface micro/nano-structures by temporally shaped fs laser pulses: Controlled ripple patterning on Si & ZnO



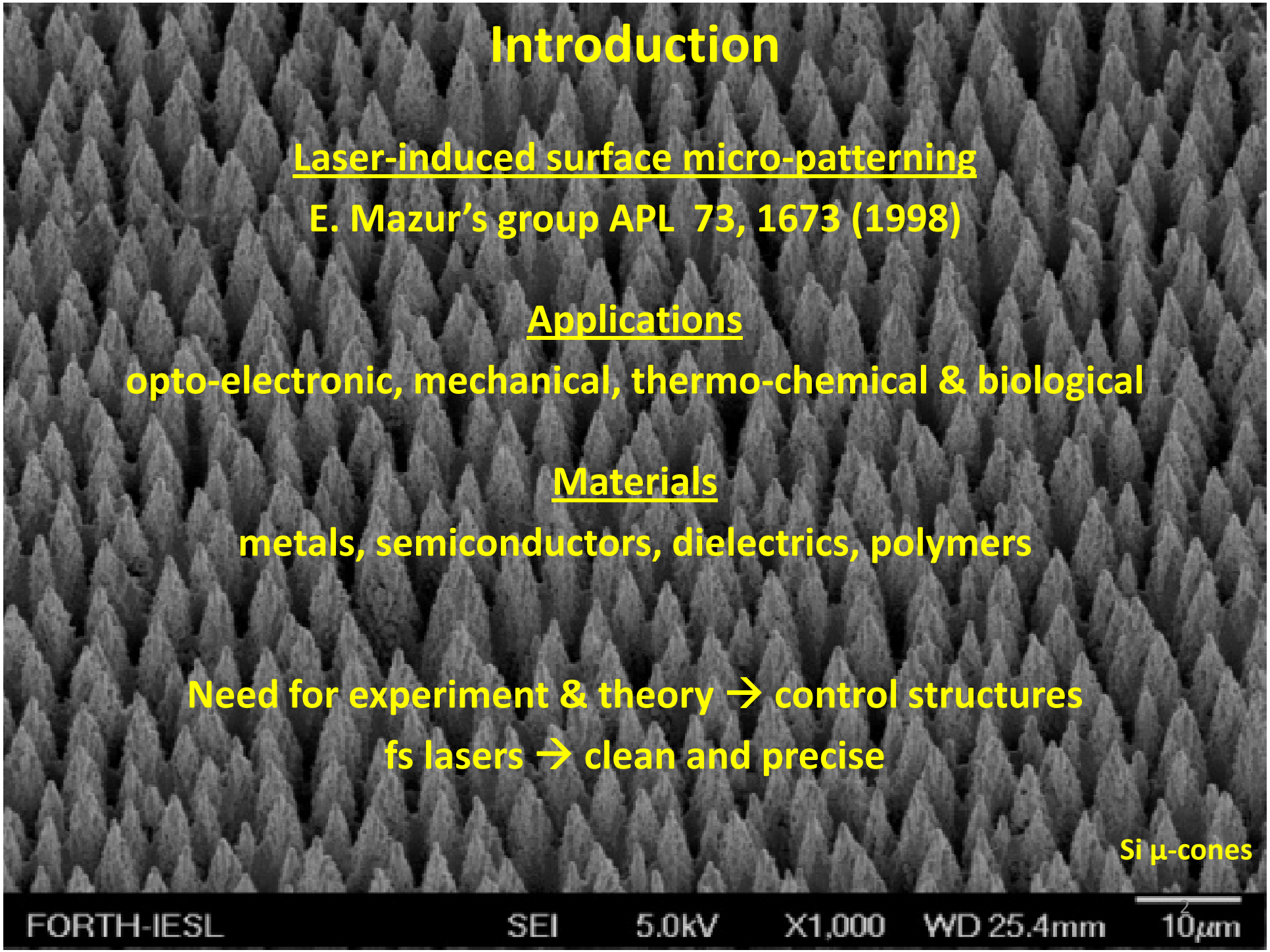


Panos Loukakos, Manos Stratakis, George Tsibidis, Costas Fotakis

www.iesl.forth.gr

Combined Laser Nanotechnology (CLaN) 2014
Final meeting, July 9-12, Maratea, Italia

Introduction



Summary

Temporal pulse shaping → control of surface micro/nano morphology

Theory:
1. Theoretical model: includes hydrodynamics in sub-ablation conditions
2. Ripples "survive" hydrodynamics
3. Model describes successfully temporal shaping effects

Si:
1. Crater size decreases with τ_D showing dependence on $T_{c\text{-}max}$ rather than $T_{l\text{-}max}$
2. Ripple period decreases due to decreasing $T_{c\text{-}max}$ and N → decreasing λ_{SPW}

ZnO:
1. Observation of 3 different ripple periods
2. Switching between ripple periodicity with appropriate pulse shape

Next steps:
1. Extension to grooves & μ-cones
2. Different materials (metals, ceramics, polymers)
3. Complex pulse shapes/feedback & genetic algorithms

Our recent relevant papers:

1. Phys. Rev. B **86**, 115316 (2012)
2. Optics Express **21**, 18501 (2013)
3. Appl. Phys. A **113**, 273 (2013)
4. Appl. Phys. A **114**, 57 (2014)

(Ir-)Relevant People:

Experiment: **Panos Loukakos** *loukakos@iesl.forth.gr*
Experiment: **Manos Stratakis** *stratak@iesl.forth.gr*
Theory : **George Tsibidis** *tsibidis@iesl.forth.gr*
Mentor : **Costas Fotakis** *fotakis@iesl.forth.gr*

FS LASER SPECTROSCOPY IN SOLID STATE

FLASSS

Practical messages

1. **Ultrafast pump-probe spectroscopy for e.g.**
   a) electron-lattice interactions in metallic nanosystems
   b) Carrier trapping in semiconductors and quantum dots
   c) Exciton generation and dissociation dynamics in hybrid cells
   d) Charge transfer dynamics in molecular systems

2. **Controlled micro/nanostruturing on surfaces & interfaces for e.g.**
   a) Studying the fundamental processes during strong laser-surface interactions
   b) Preparing scaffolds for optical or biological surfaces
   c) Creating advanced intelligent self-optimizing loops & light-matter synergies with genetic algorithms