

Deposition of multilayer optical coating on corugated surface and applications for high-power lasers



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CENTRAS

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***icrea**

Institució catalana de recerca i estudis avançats

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Kvantinės elektronikos katedra
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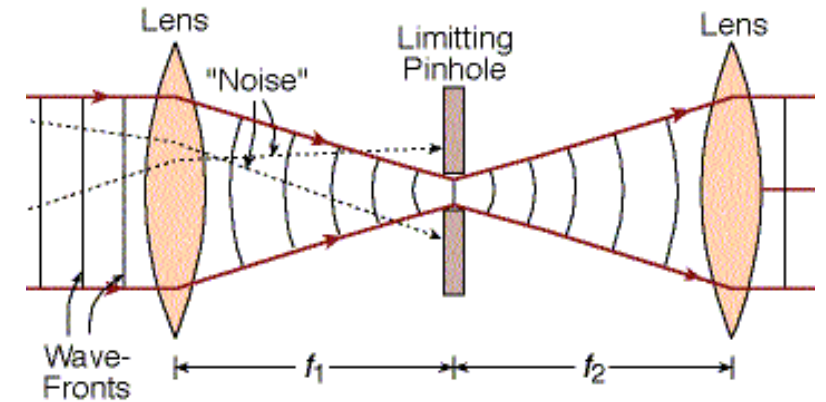
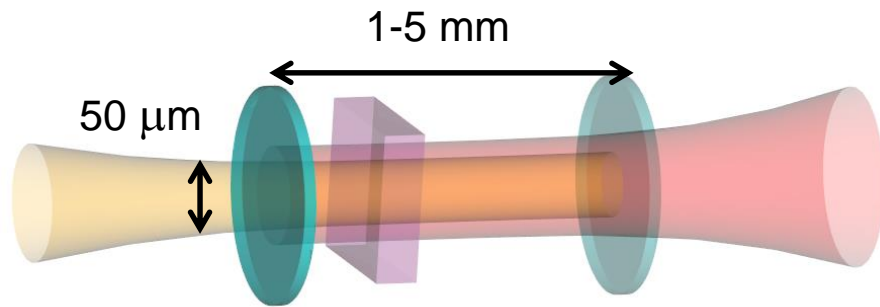


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Ceren Babaiygit

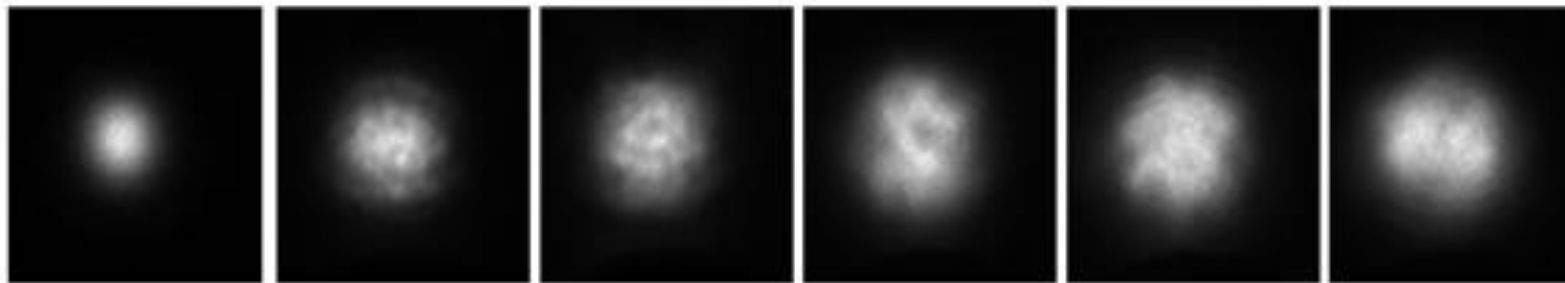
Mirbek Turduev

Hamza Kurt

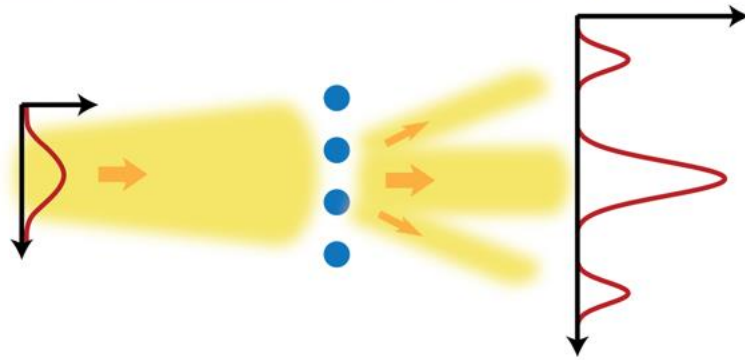


Conventional filtering as in big laser systems is not applicable for microlasers

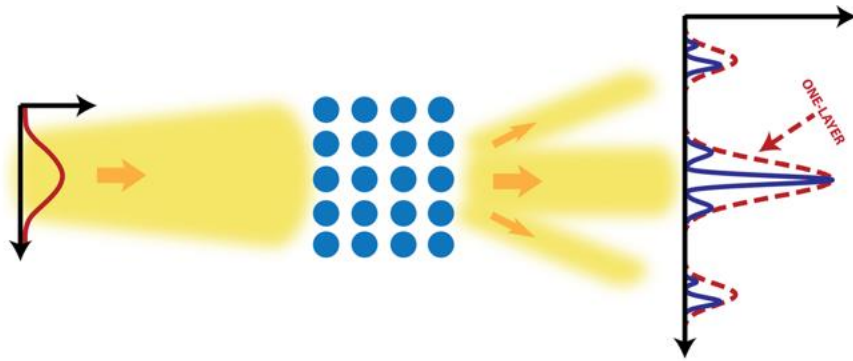
Increasing pumping power



The far-field profiles of laser beam

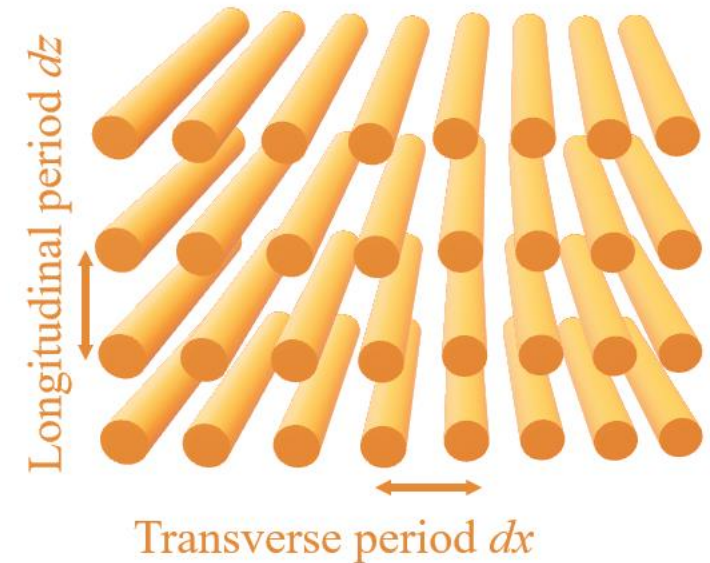


! The modified diffraction depends on the longitudinal and transverse periodicities

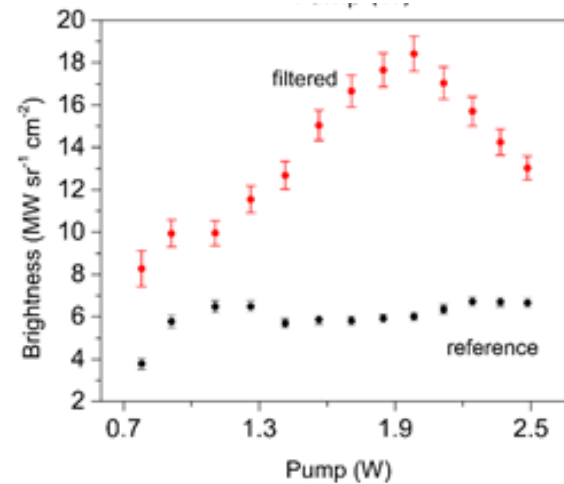
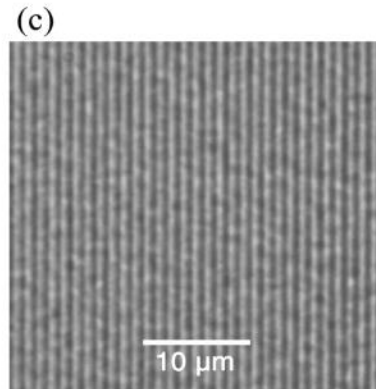
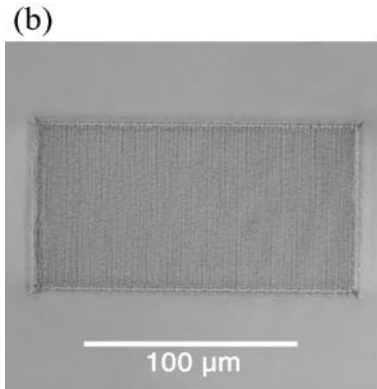
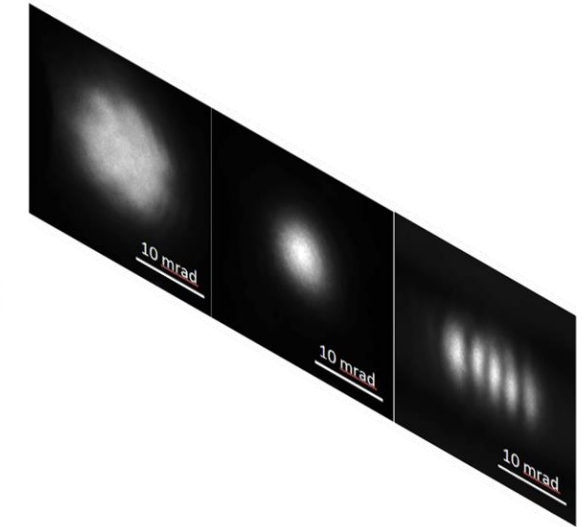
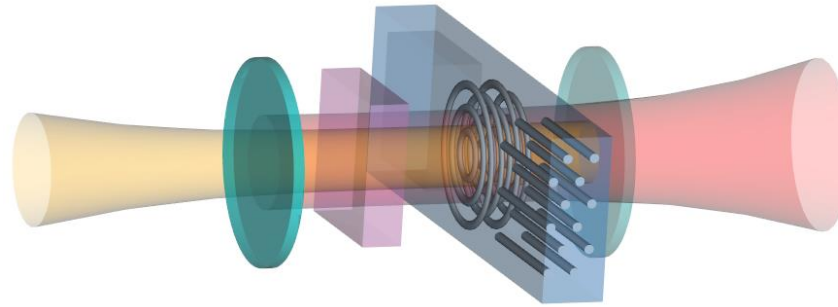
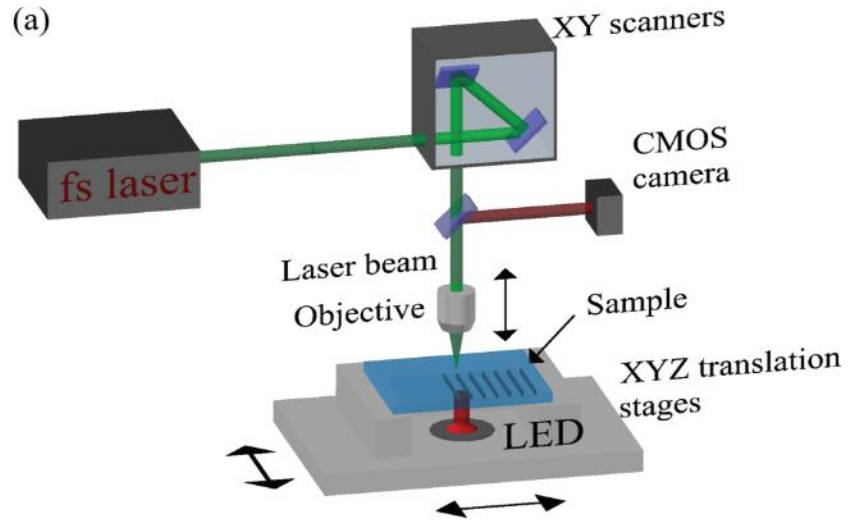


! It is tunable by the geometry of the PhCs.

2D Photonic crystal

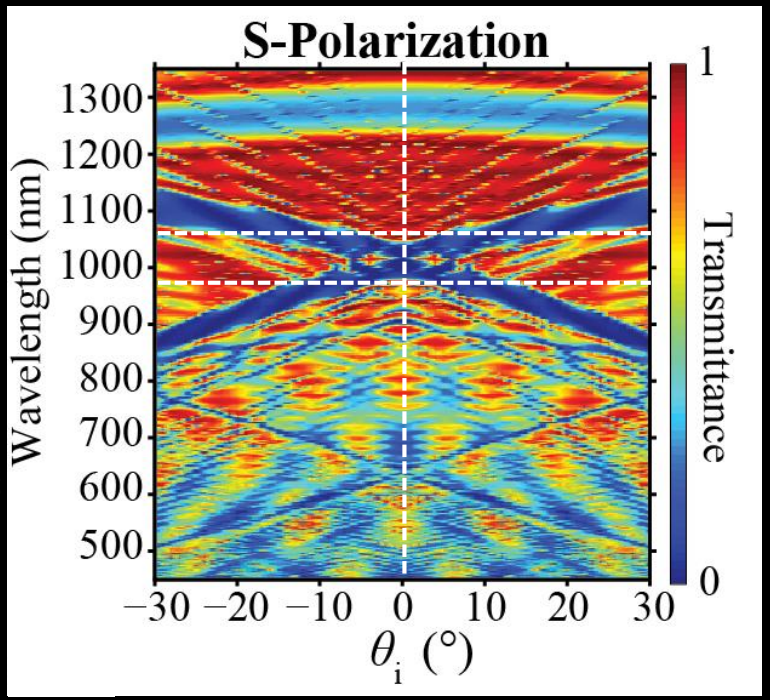
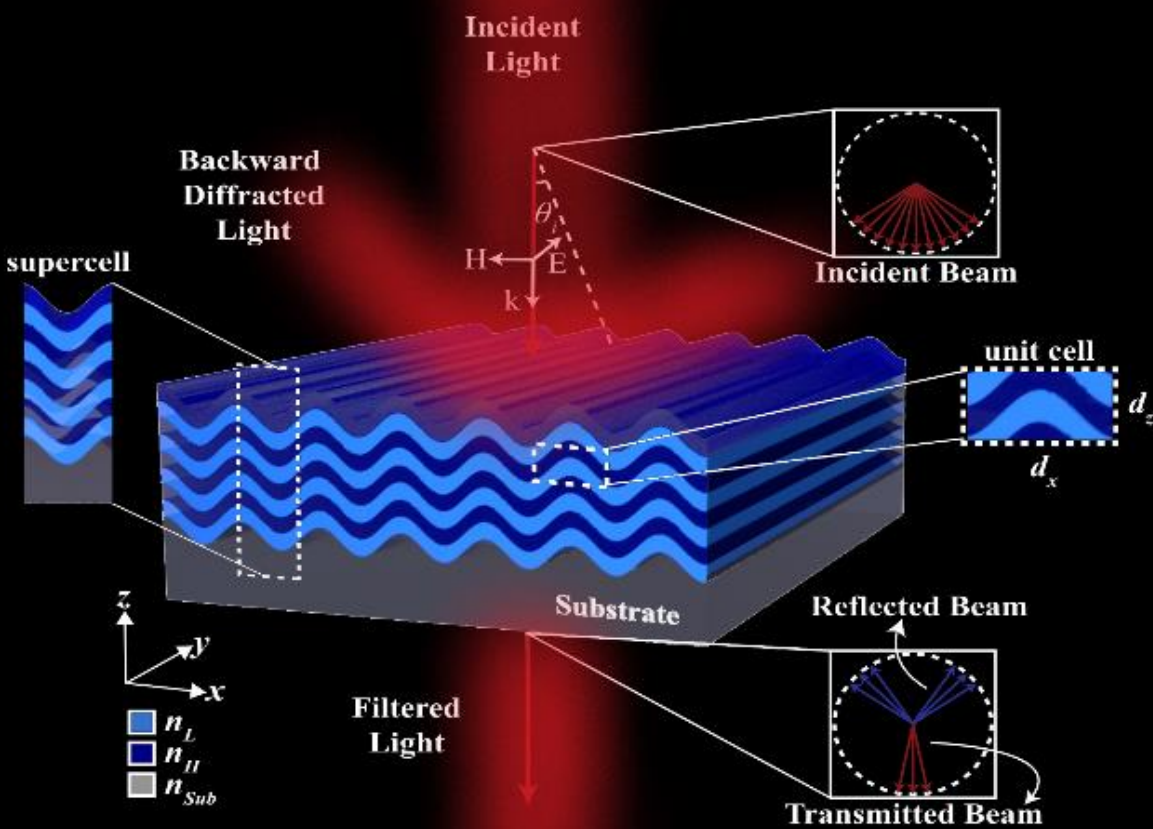


PhC fabrication – Direct Laser Writing

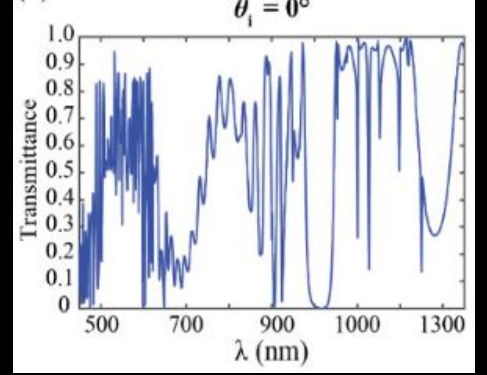
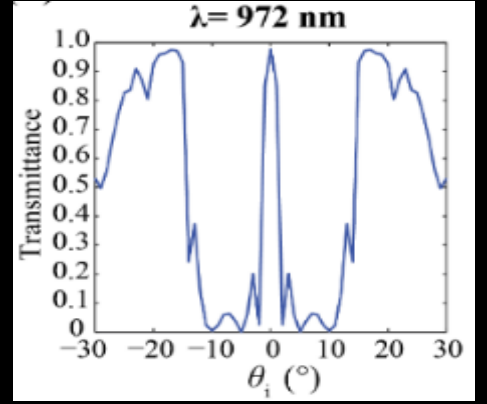
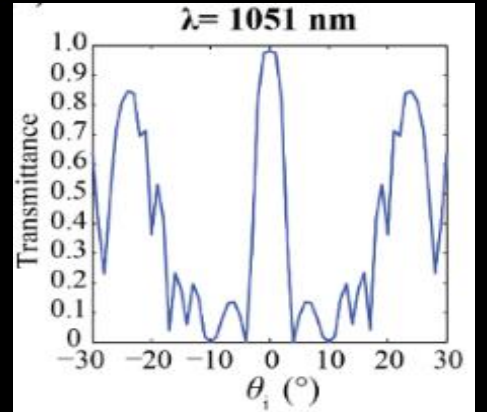


Inorganic material (glass):
 $\Delta n \sim 0.005$
Slow/expensive process
Deviations

Multilayer 2D photonic crystal



Map of transmission dependence on incidence angle and the wavelength [FDTD simulations]



Transverse period $dx - 600 \text{ nm}$ (gratings period)
 Longitudinal period $dz - 310 \text{ nm}$ (optical thickness of each layer)
 $\Delta n - 0,23$, number of layers - 33

2D photonic crystals for spatial filtering

Substrate structure:

600 nm transverse period
220 nm modulation depth

Materials:

HfO_2 $n_L = 1.99$

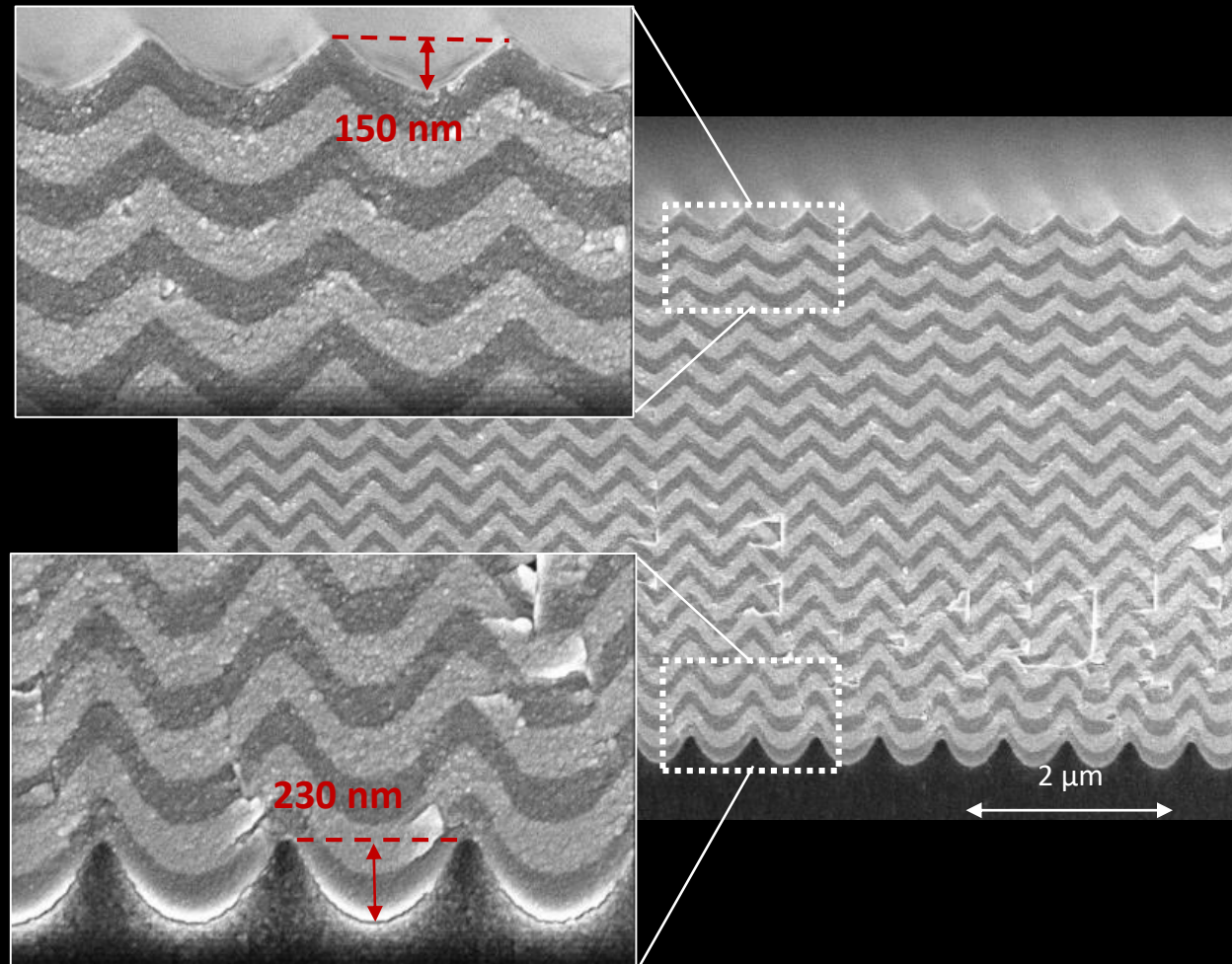
Nb_2O_5 $n_H = 2.24$

Physical thickness:

HfO_2 - 1.59.2 nm

Nb_2O_5 - 141.8 nm

33 layers (total $\sim 5\mu\text{m}$)



2D photonic crystals for spatial filtering

Substrate structure:

600 nm transverse period
220 nm modulation depth

Materials:

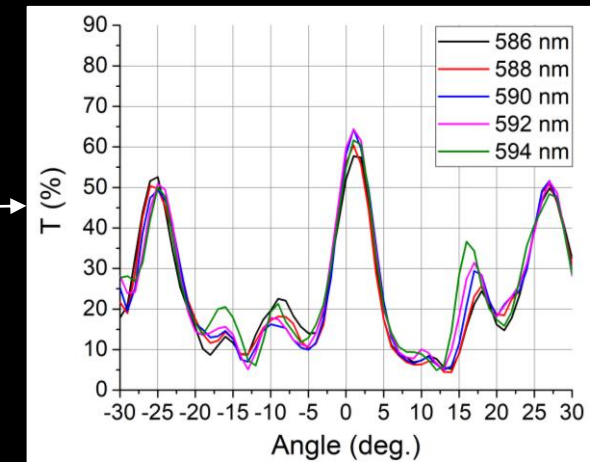
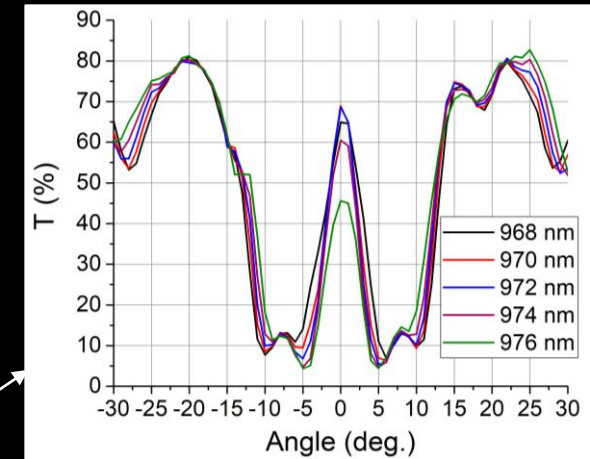
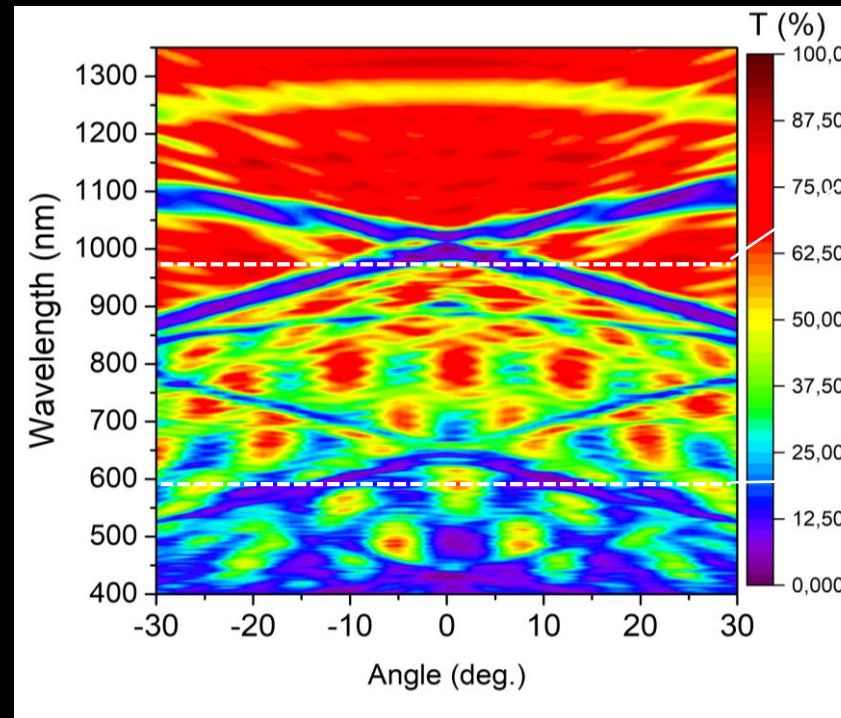
HfO_2 $n_L = 1.99$
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Physical thickness:

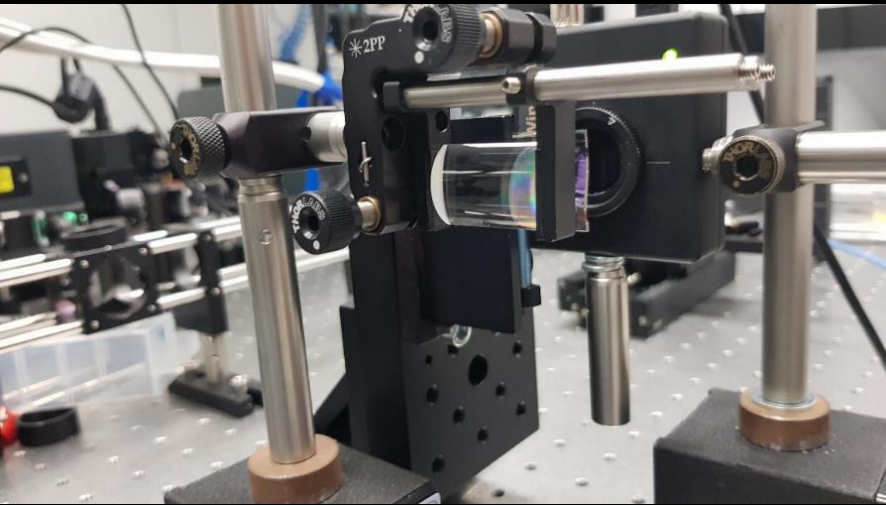
HfO_2 - 1.59.2 nm
 Nb_2O_5 - 141.8 nm

33 layers (total $\sim 5\mu\text{m}$)

S-polarization

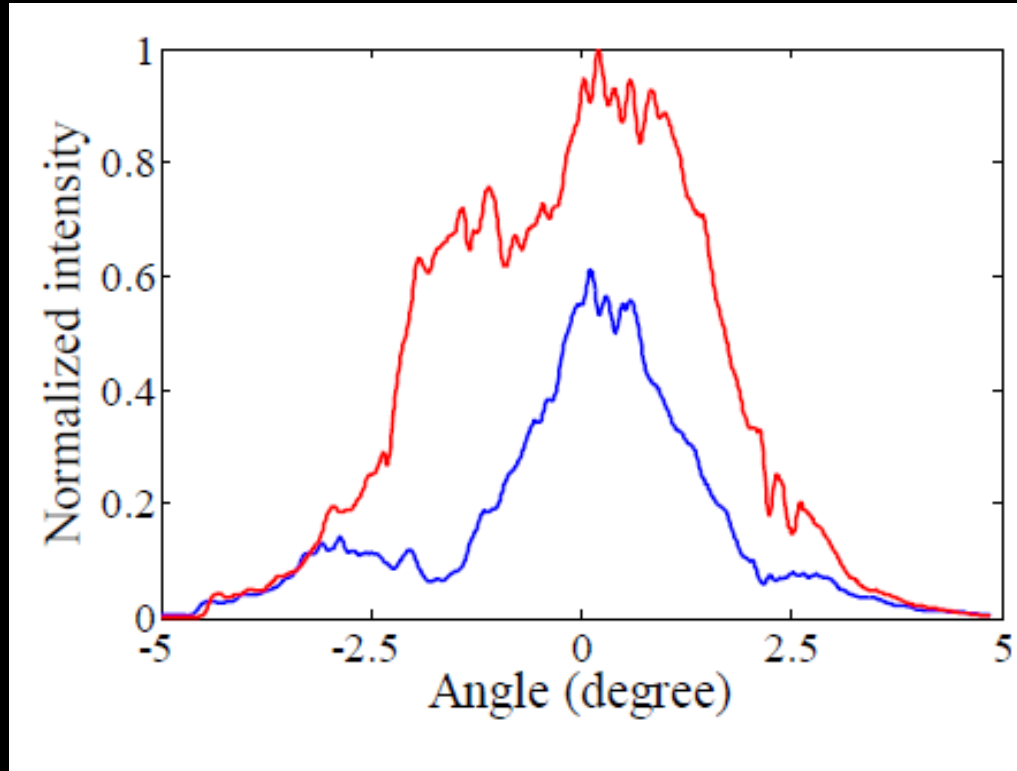


Beam profiling measurements

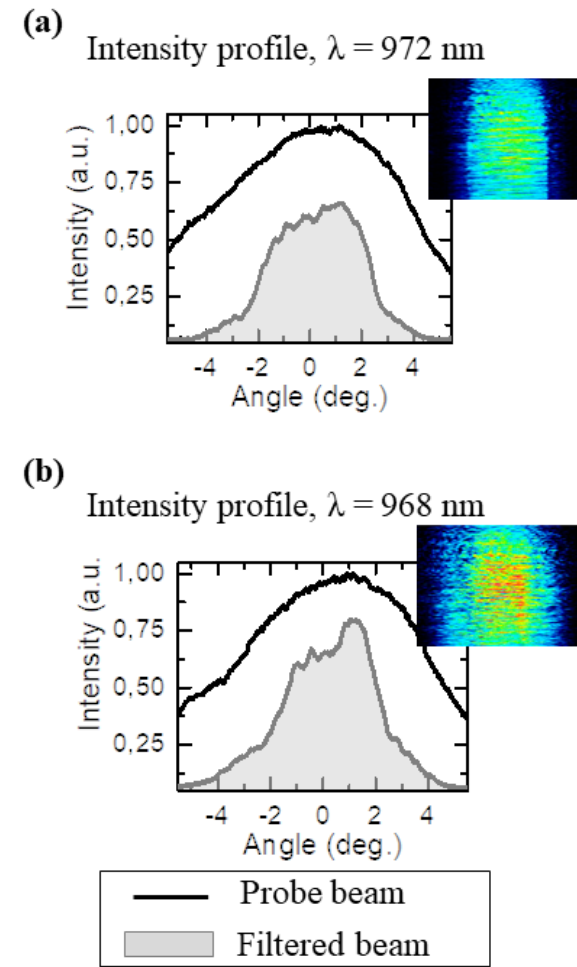


Measurements with tunable picosecond laser at $958 \text{ nm} \leq \lambda \leq 980 \text{ nm}$

The angular divergence of the beam at FWHM is $\sim 2^\circ$



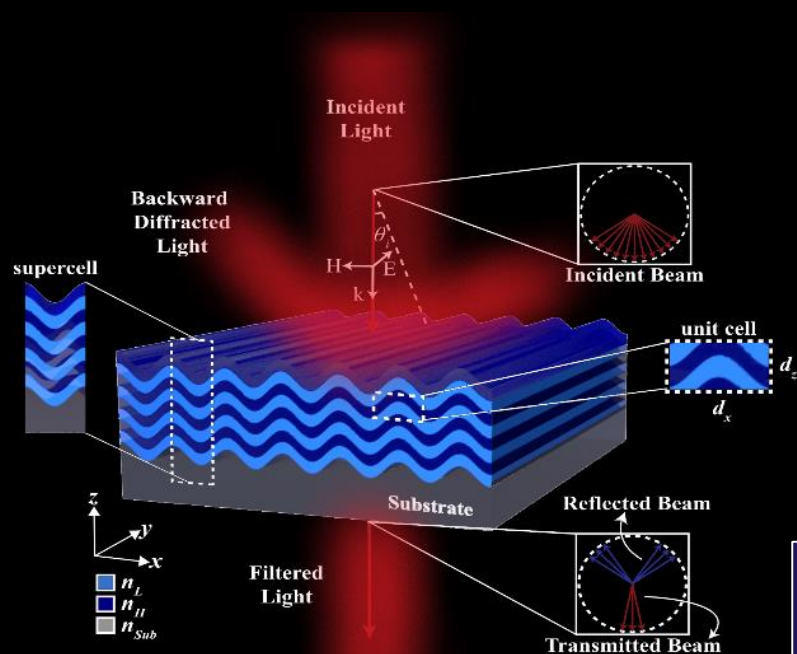
The single pass transmission measured with and without sample. The drive current - 4 A that gives output optical power of around 500 mW.



Conclusions

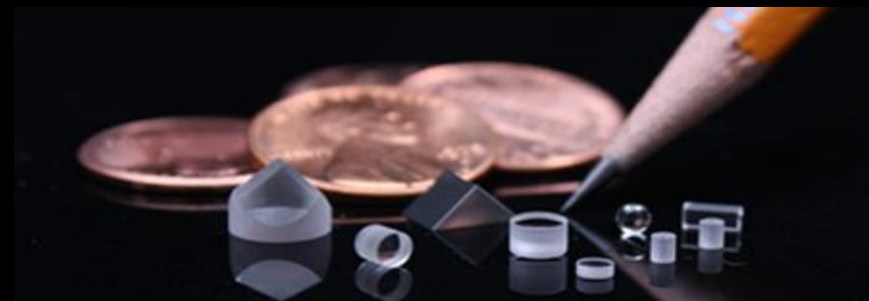
- 2D photonic crystals by Physical Vapour Deposition

Controllable multilayer deposition on corrugated surface



- Multilayer photonic crystal for spatial filtering

Compact element ($\sim 5\mu\text{m}$ coating thickness)
Applicable for high power lasers (inorganic oxides)
Cost efficient perspectives



<http://catalog.rossoptical.com/catalog/micro-optics/>

Thank you for your attention

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