Distribution of Cavity-modes in Narrowband Filters with Chirped Thin-Films

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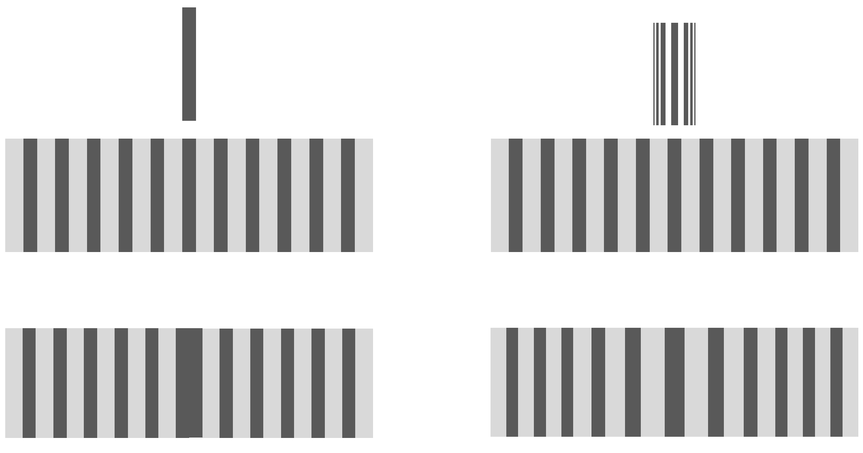
Motivation & Basic Considerations

Conventional Fabry-Pérot filter ⟶ disturbing the periodic layer sequence of a DBR with an extra layer

Distributing this disturbance over all layers of a DBR ⟶ chirped, resonant thin-film filter



Variation of chirp influences the spatial distribution of the resonant mode in the layer stack

High Q factors can be maintained

Numerical Simulations

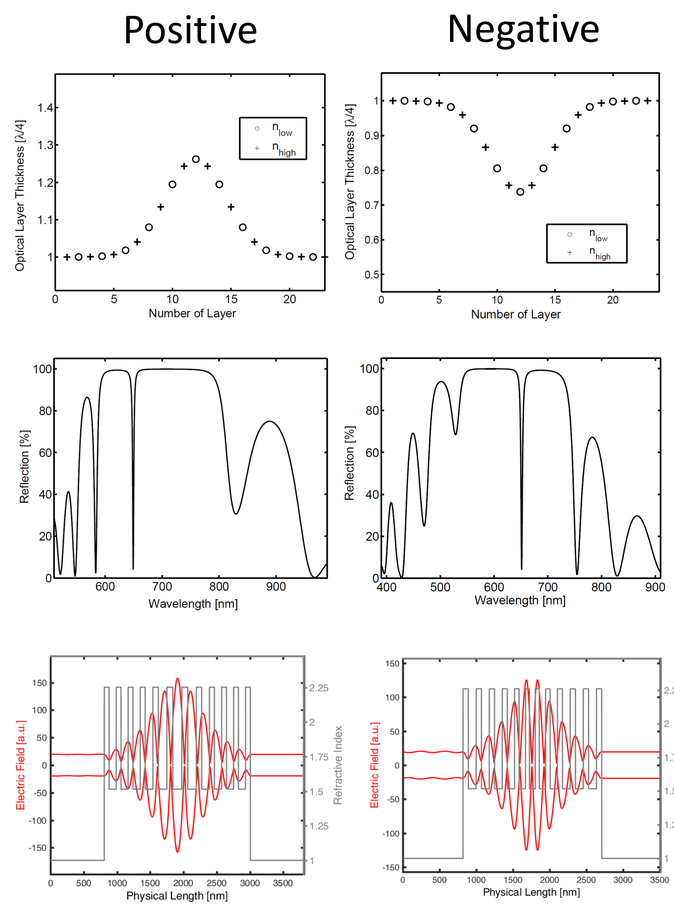
Filter properties calculated with the Transfer Matrix Method (TMM)

Positive and negative chirp distribution possible

Stopband with narrow transmission line can be achieved

Electric field distribution of mode is influenced by chirp

Refractive index contrast and number of periods have similar impact as in conventional filters

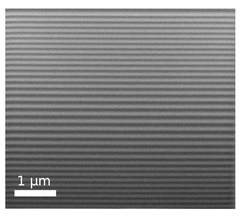


Experimental Results

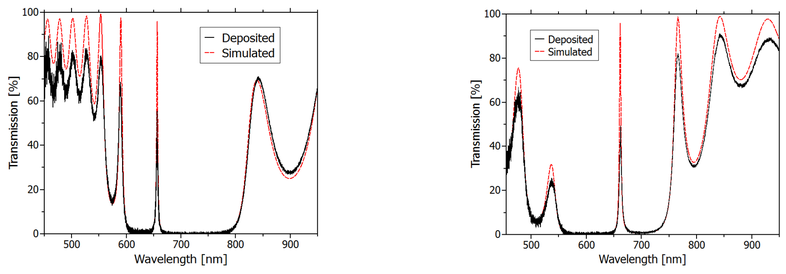
Chirped filters were deposited by ion beam sputtering

Low index material SiO_2, n = 1.47

High index material Nb_2O_5, n = 2.25



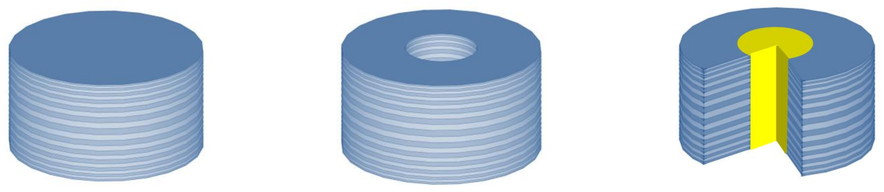
Optical characterization in good agreement to simulations



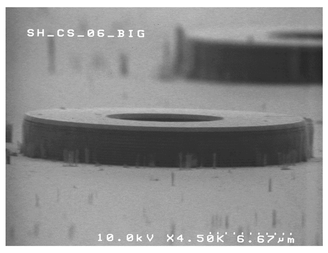
Positive Negative

Lasers with Chirped Layers

Fabrication of a hollow cylinder structure and infiltration with active material ⟶ emission from core couples to resonant ring

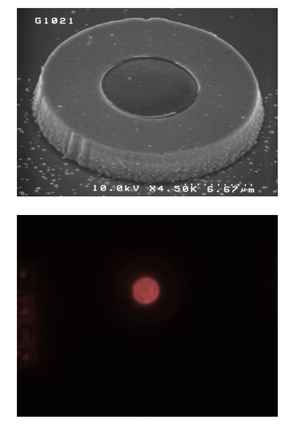


Chirped filter fabrication | Structuring (Hollow micro cylinder) | Active material infiltration



ICP-RIE etching of chirped, dielectric multilayers

Infiltration of colloidal quantum dots (cQD) in polymer host matrix



4.2 nm diameter of CdSe core

1 nm thick CdZnS/ZnS shell

Tri-n-octylphosphine and oleic acid passivation

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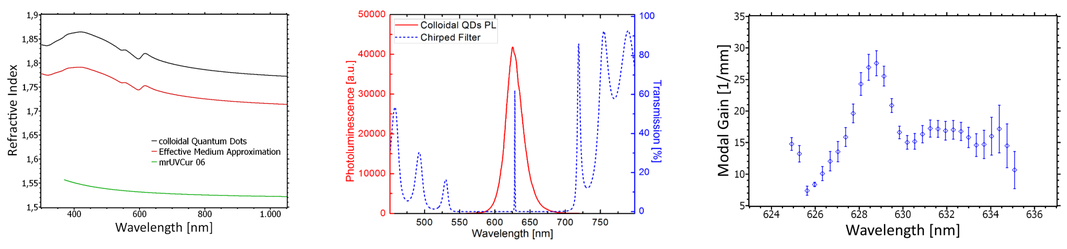
Optical characterization of the cQD/polymer compound



Outlook

3D numerical simulations to optimize mode overlap from core to chirped ring and optical coupling

Fabrication of an optimized laser structure

Characterization of the emission properties

Design and implementation of arrayed structures

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