SELF-ASSEMBLED DISORDER

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PhOREMOST

CSIC

OVERVIEW

- Disorder in thin films
- Random media: Photonic Glasses
- Conclusions

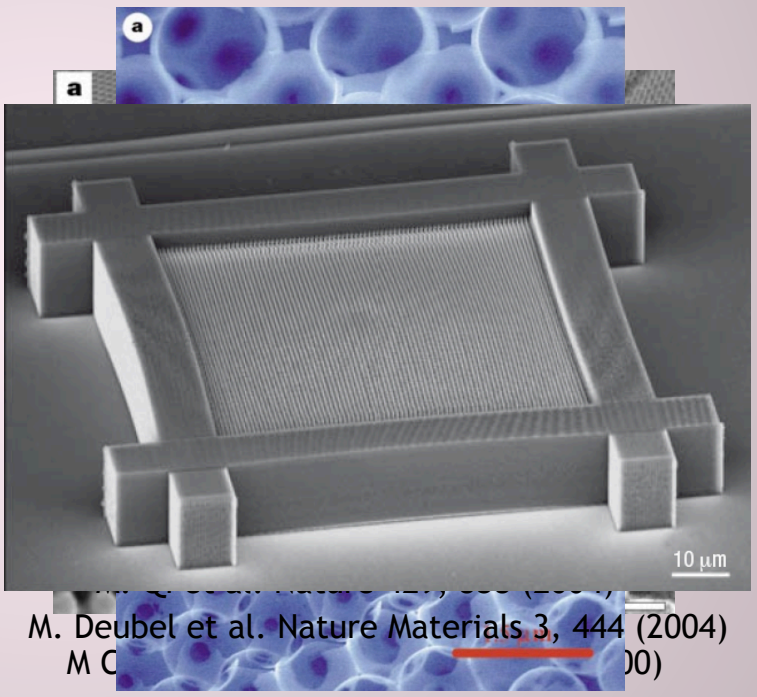
3D photonic crystals

Lithography

Holography

DLW

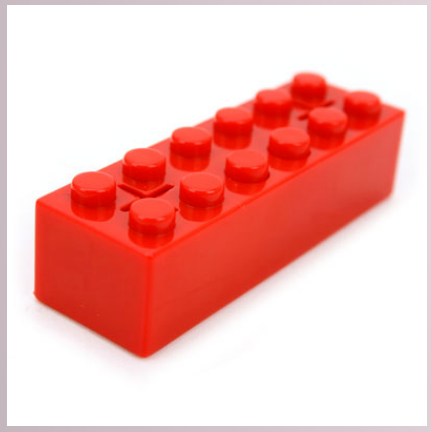
Self-Assembly



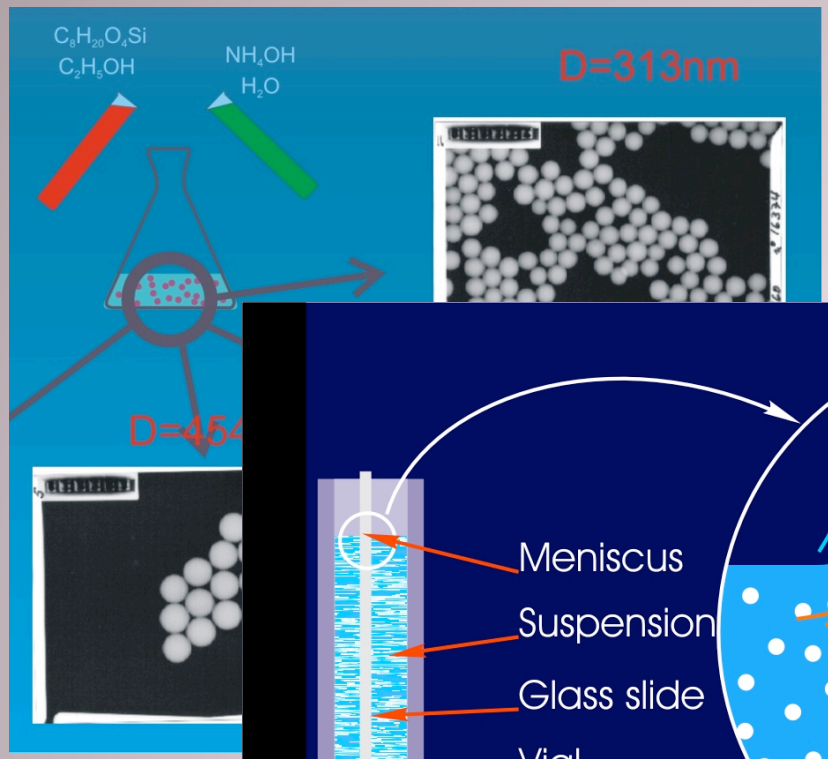
M. Deubel et al. Nature Materials 3, 444 (2004)

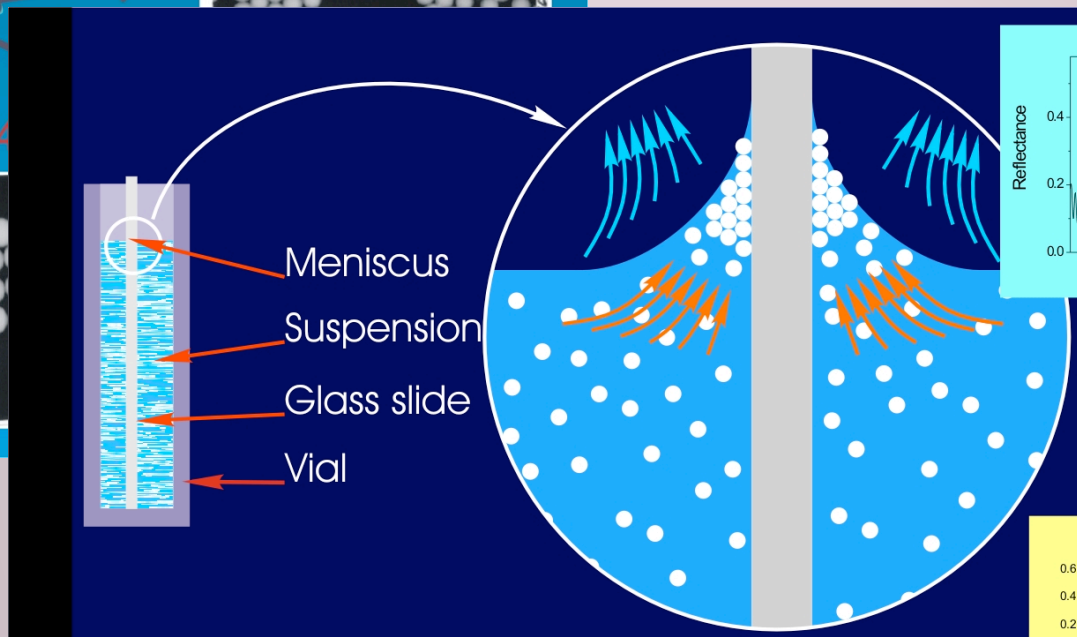
A Blanco et al. Nature 405, 437 (2000)

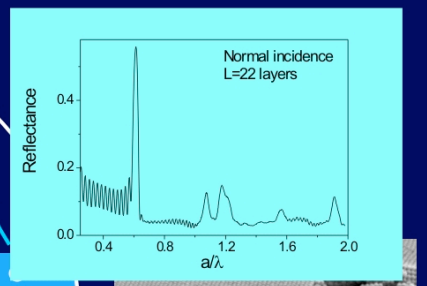
Self-Assembly

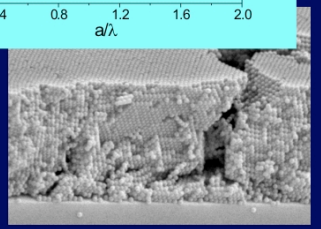


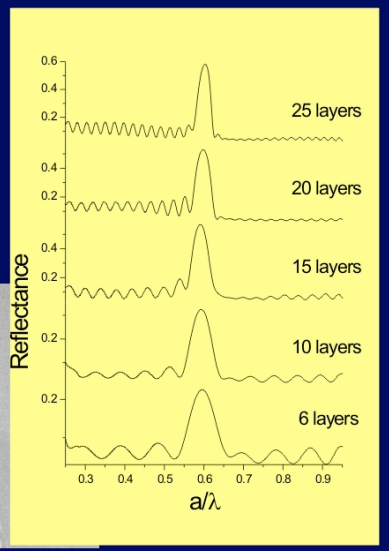
Vertical Deposition

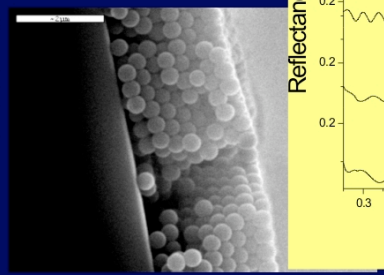








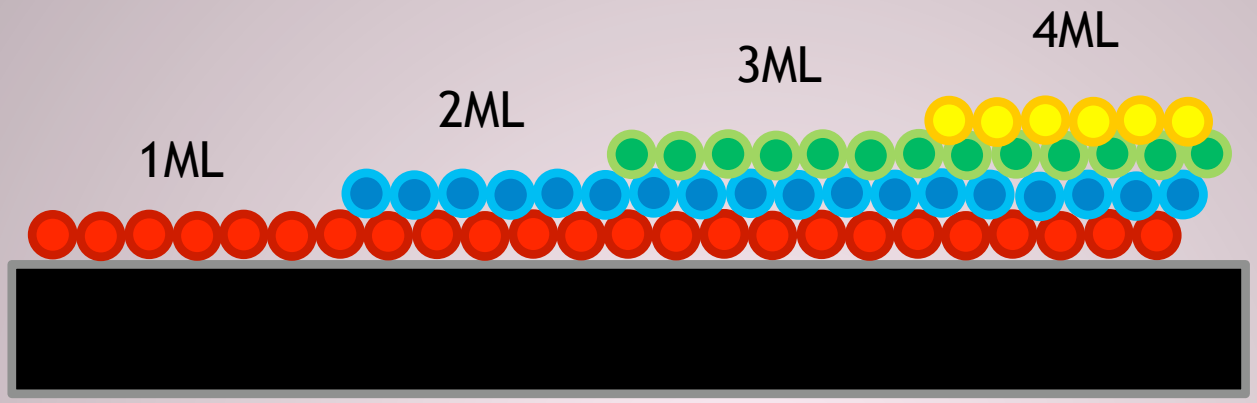


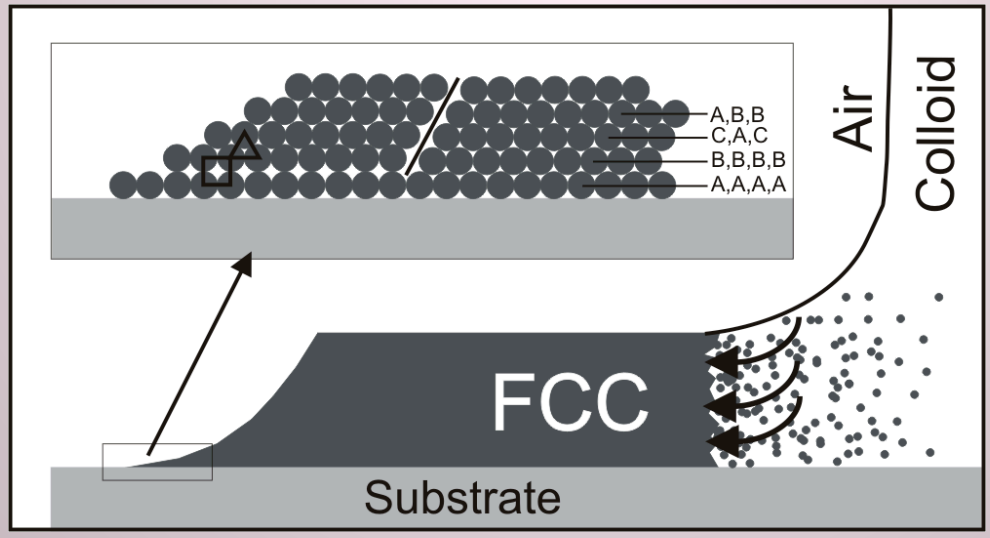


Vertical deposition

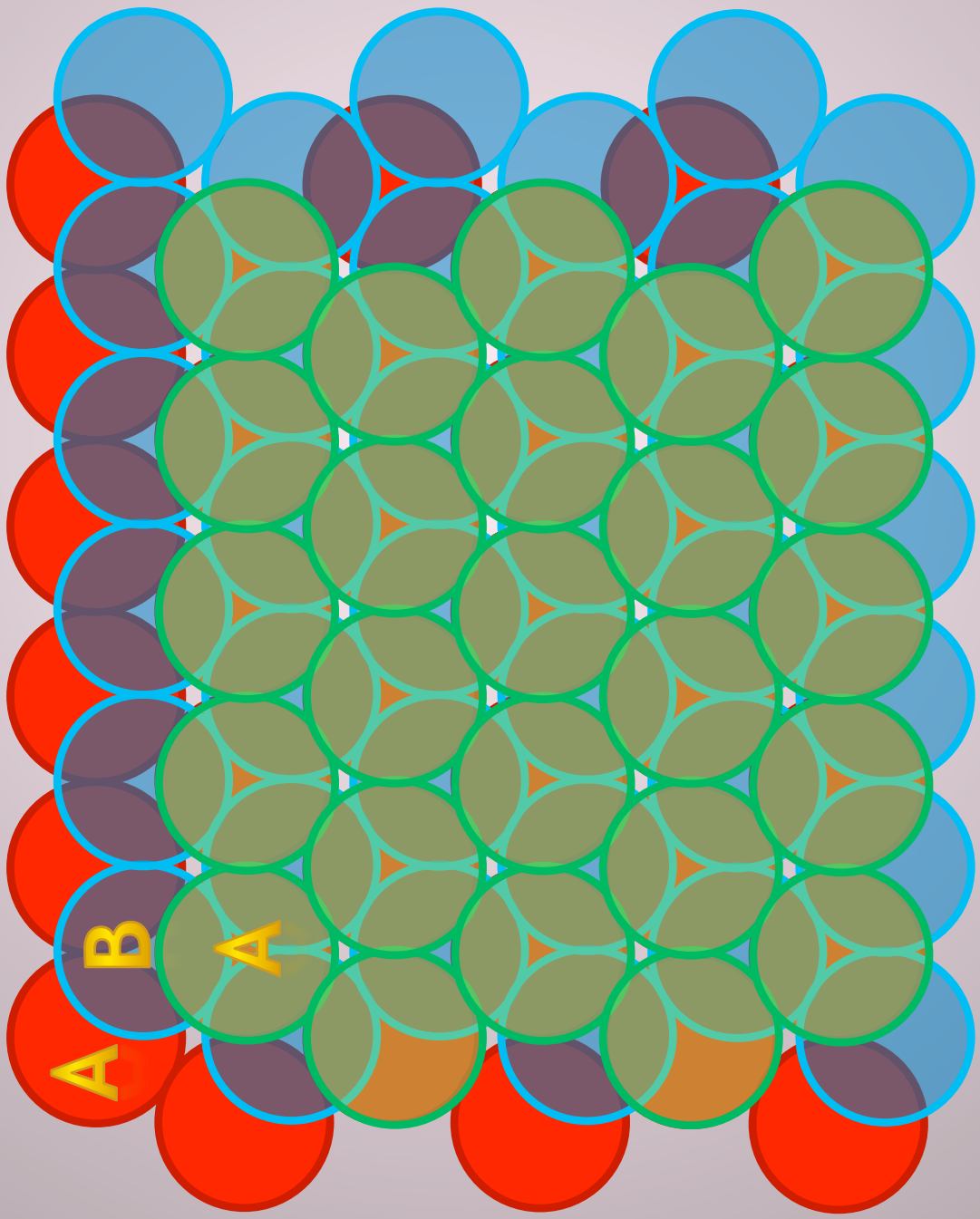
Beads in the colloid are driven toward the meniscus region by capilary forces. As evaporation sweeps the meniscus region down through the vertical glass a thin continuos uniform film is deposited. Thicknes can be controlled through several parameters such as bead diameter, colloid fraction, meniscus height (surface tension), and rate of evaporation. Thus films from one to hundreds of layers can be grown.

Disorder in thin films





Disorder in thin films



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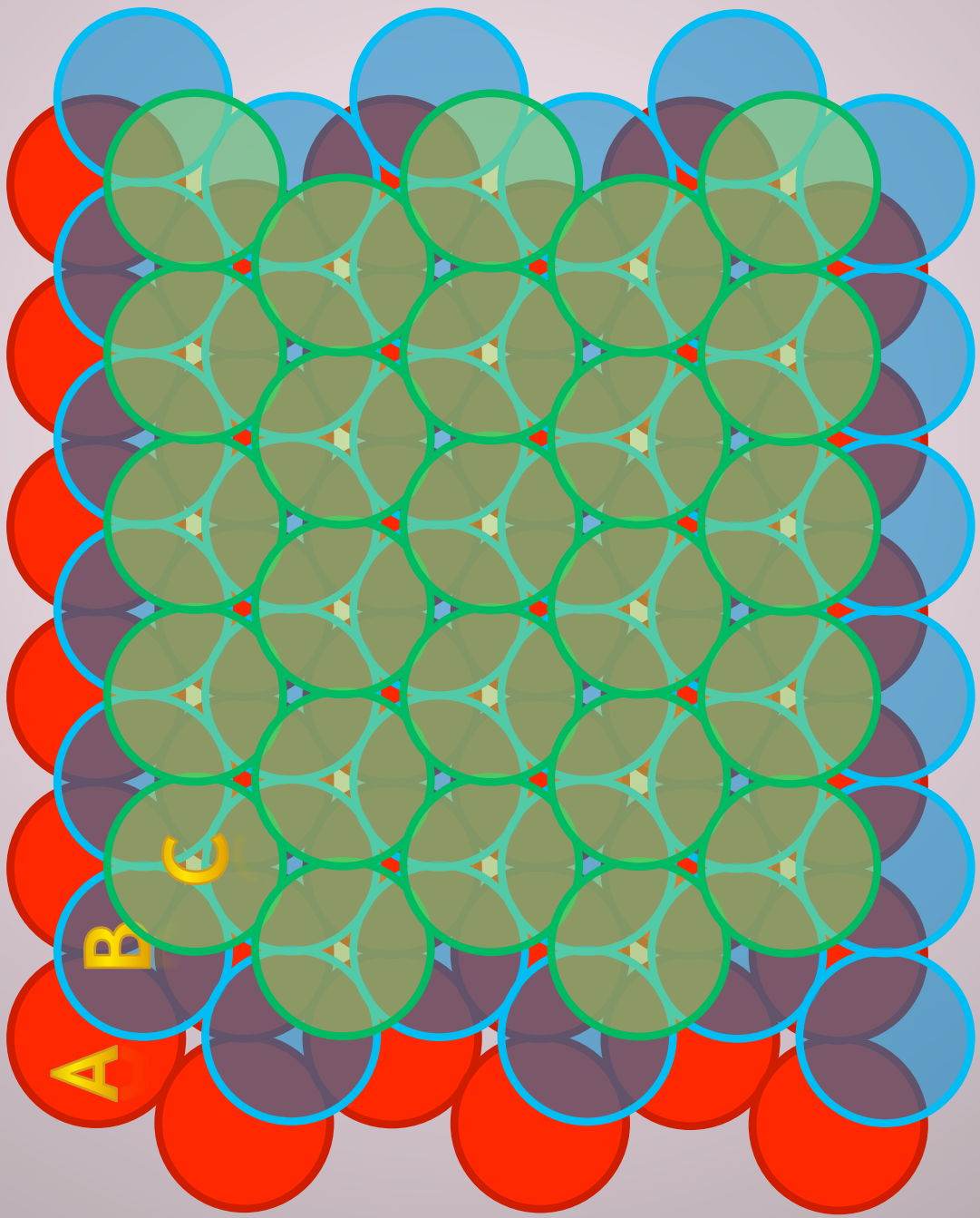
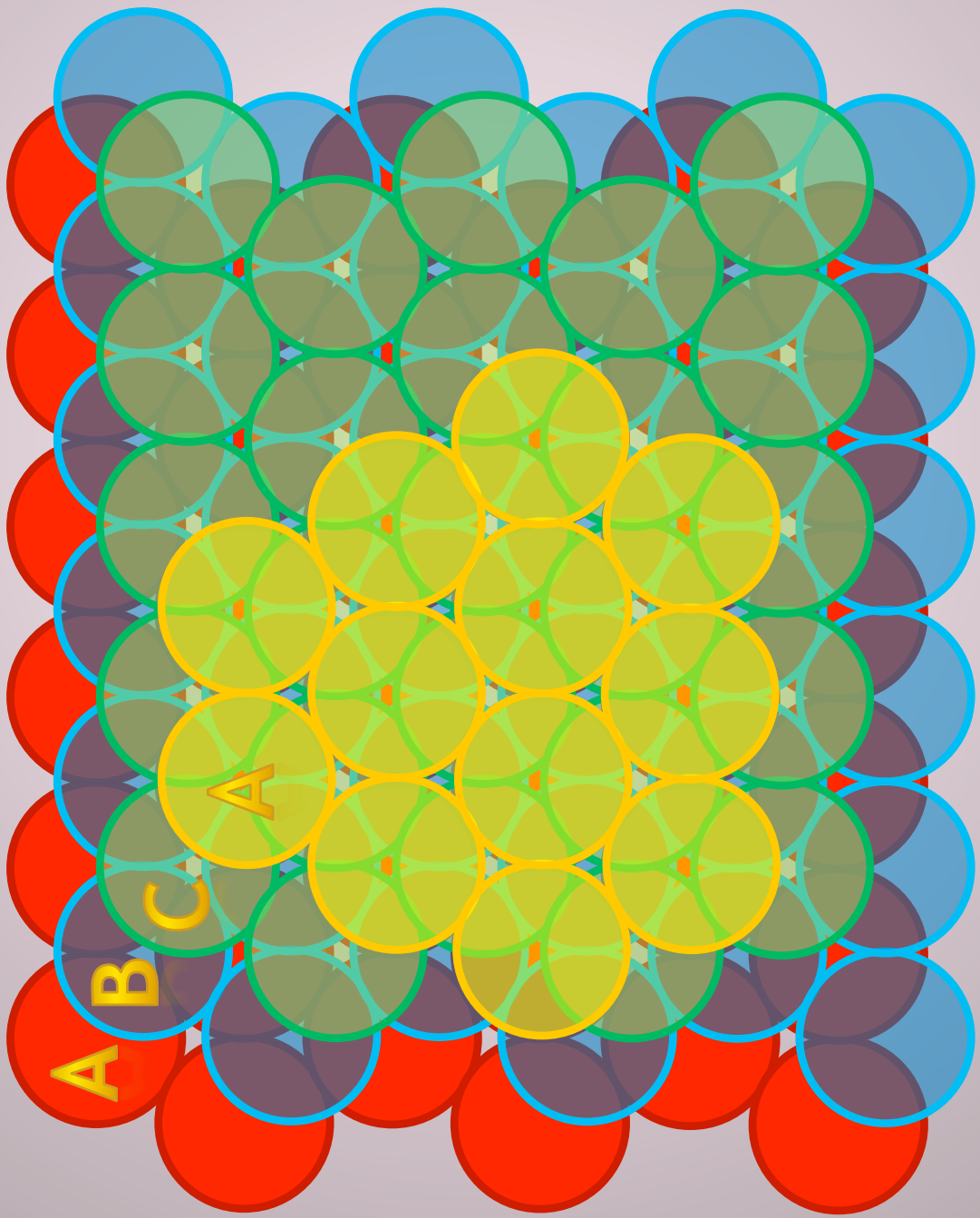
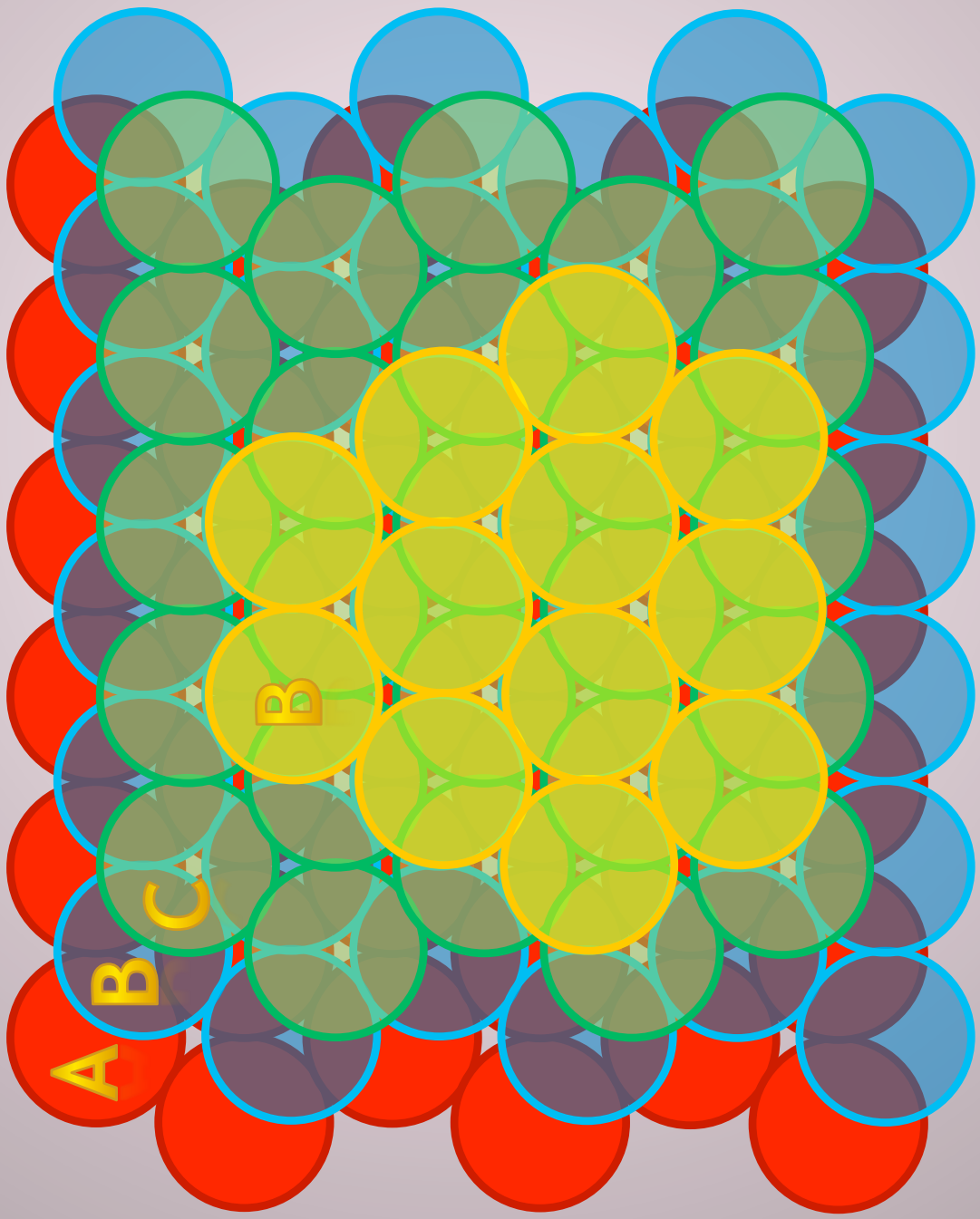


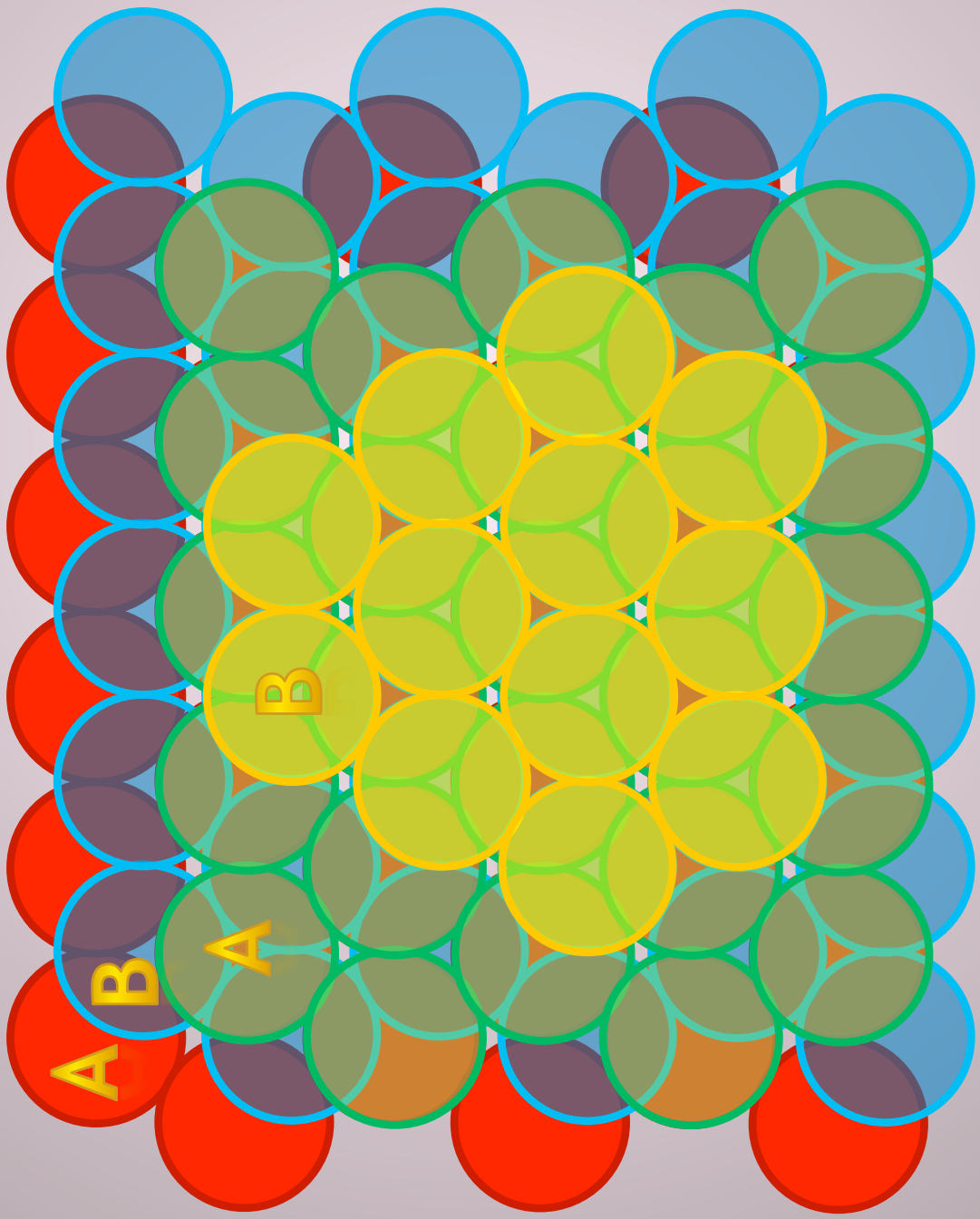
Disorder in thin films



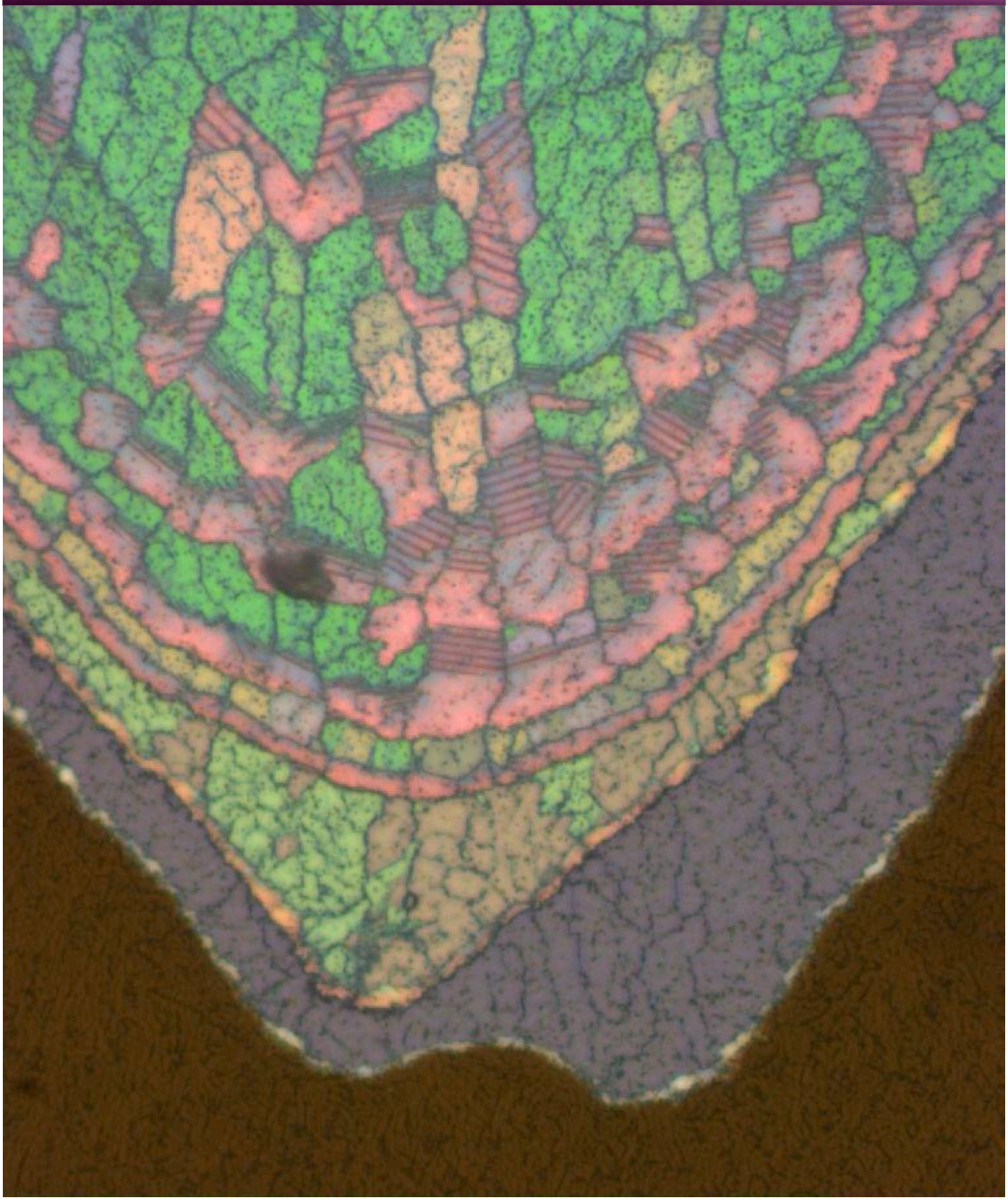
Disorder in thin films



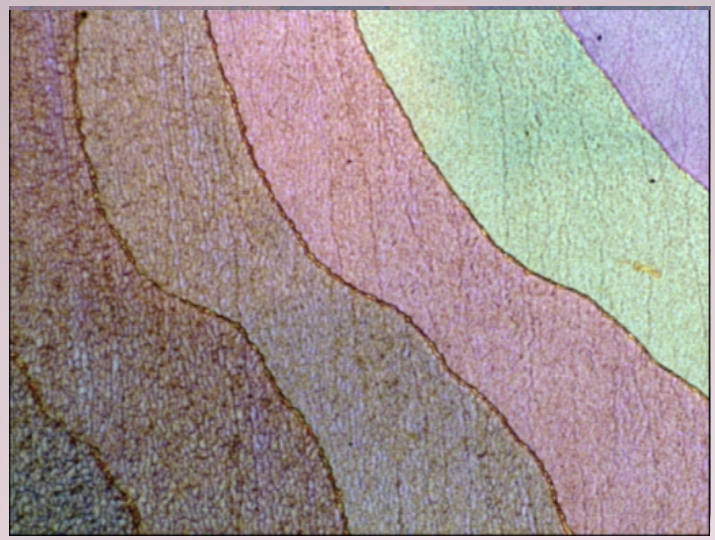
Disorder in thin films

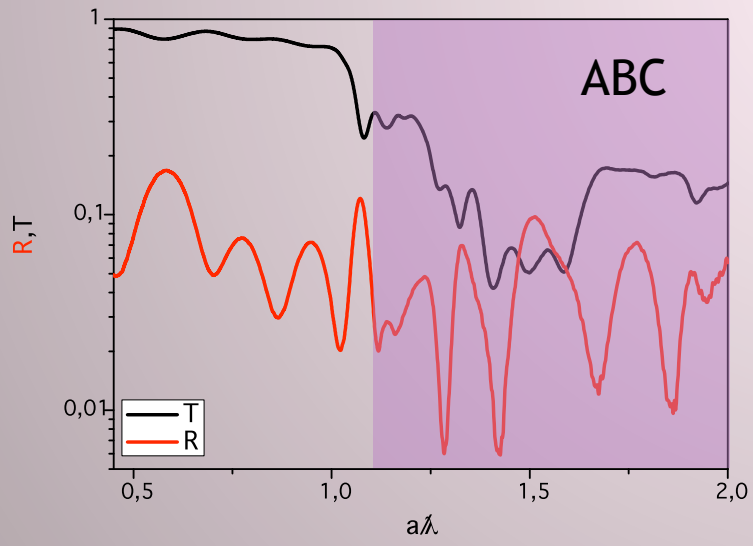


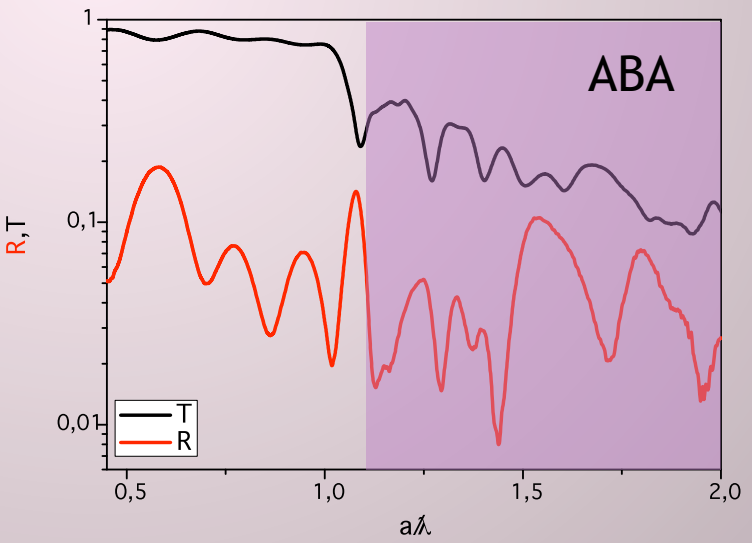
Disorder in thin films



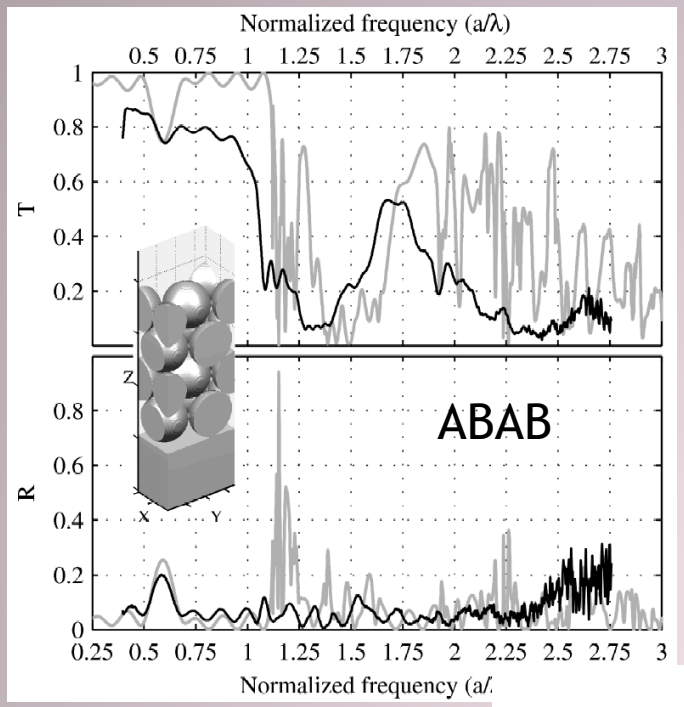
Disorder in thin films

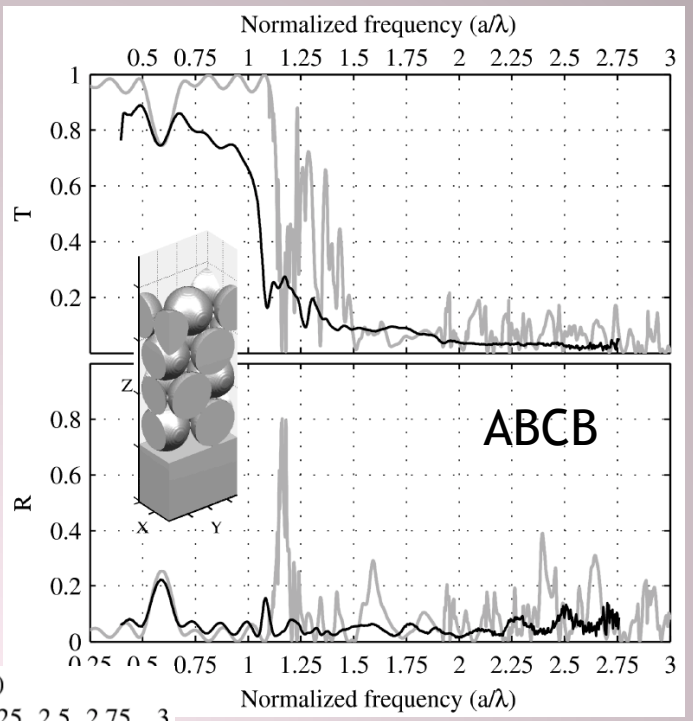


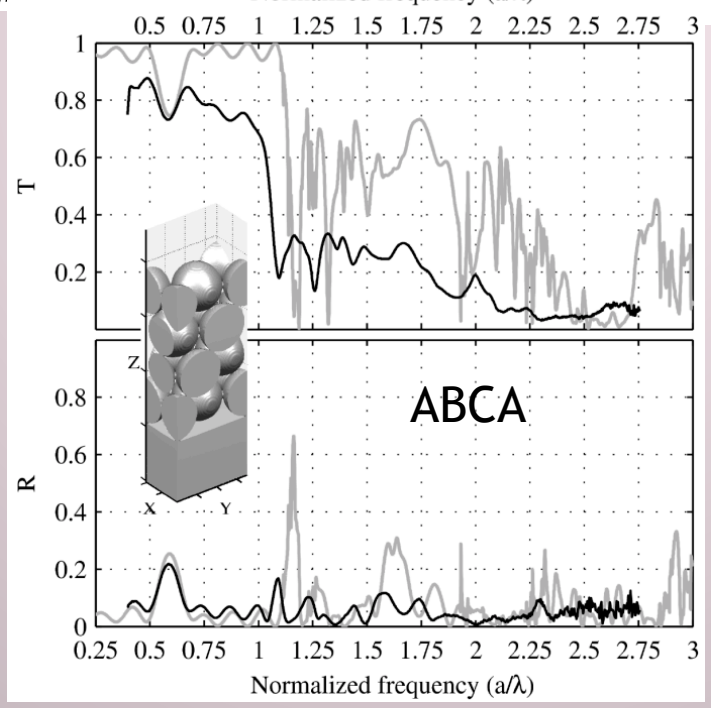




Disorder in thin films

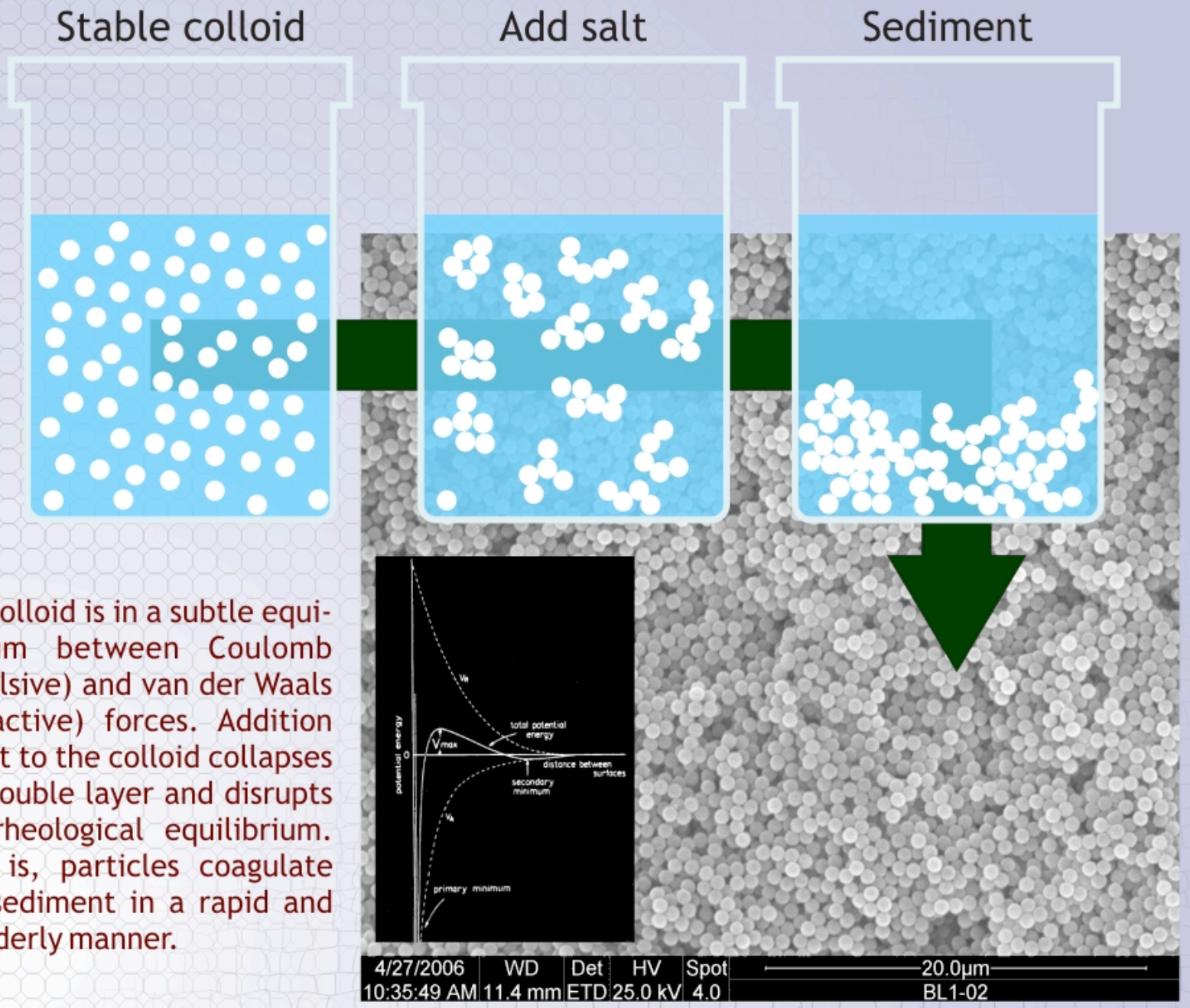






X. Checoury et al. Appl. Phys. Lett. **90**, 161131 (2007)

Rheological destabilization

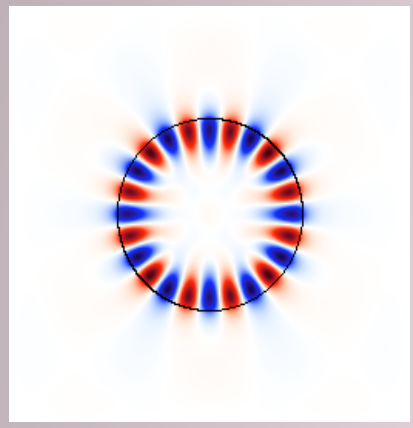


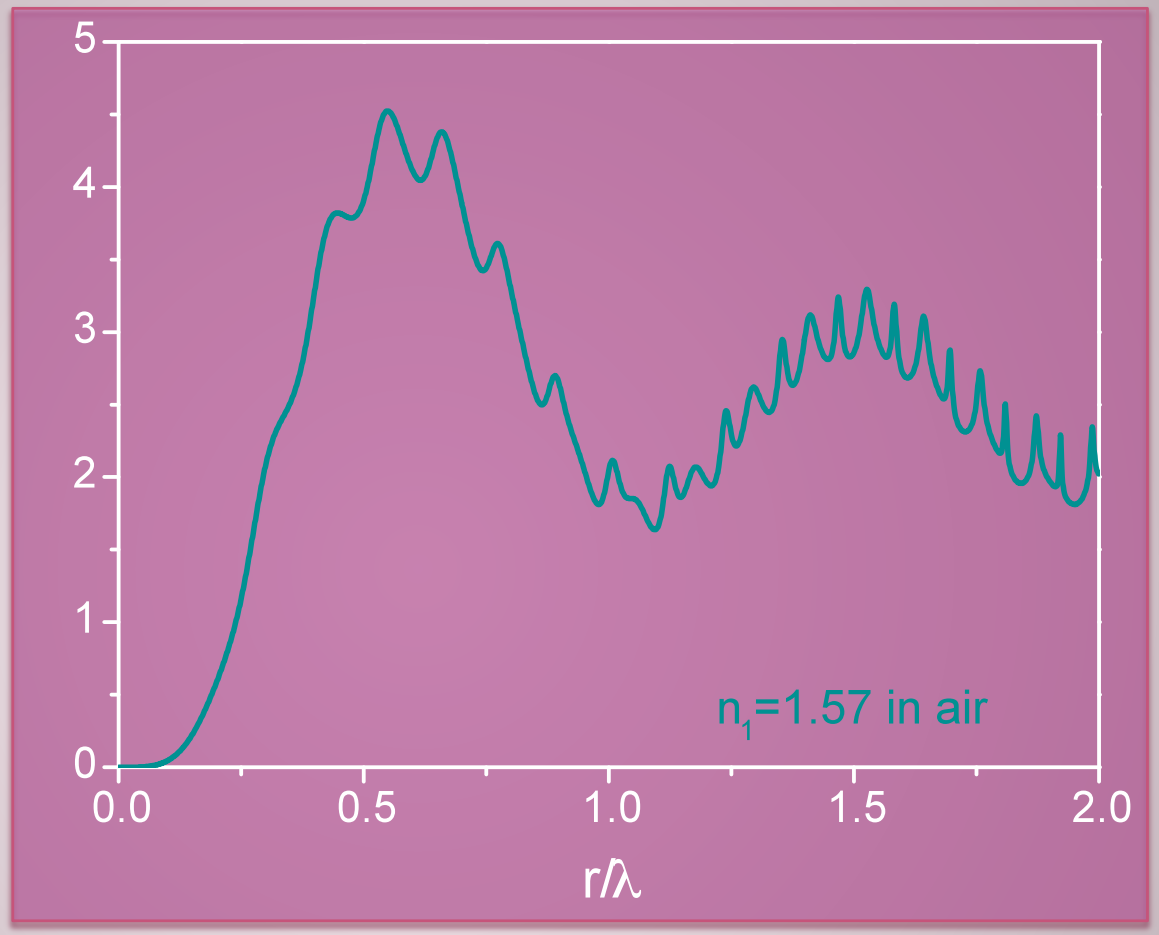
The colloid is in a subtle equilibrium between Coulomb (repulsive) and van der Waals (attractive) forces. Addition of salt to the colloid collapses the double layer and disrupts the rheological equilibrium. That is, particles coagulate and sediment in a rapid and disorderly manner.

"Photonic Glass"

P.D. García et al. Advanced Materials 19, 2597 (2007)

One dielectric sphere

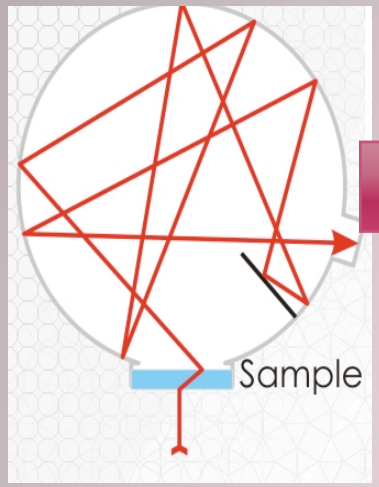


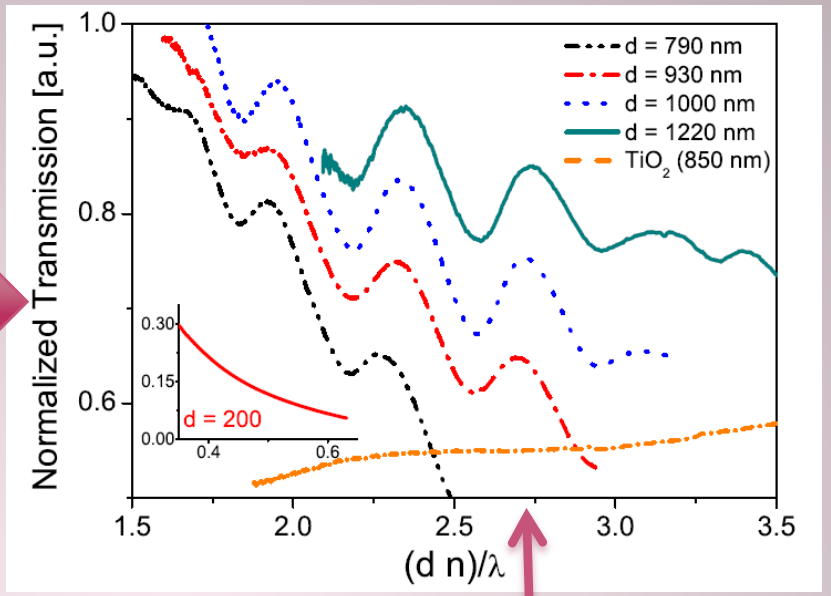


All the scattering parameters can become resonant

Random Media: Photonic Glasses

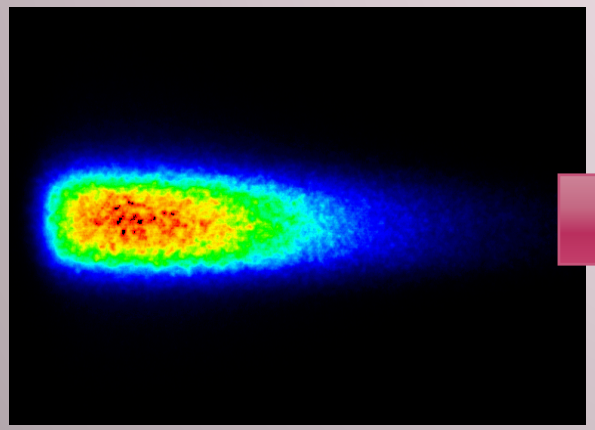
Static

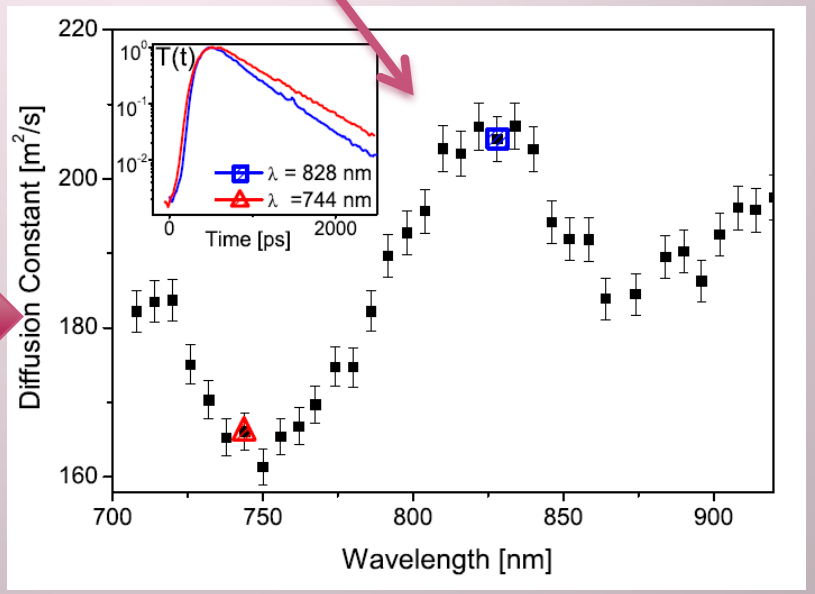


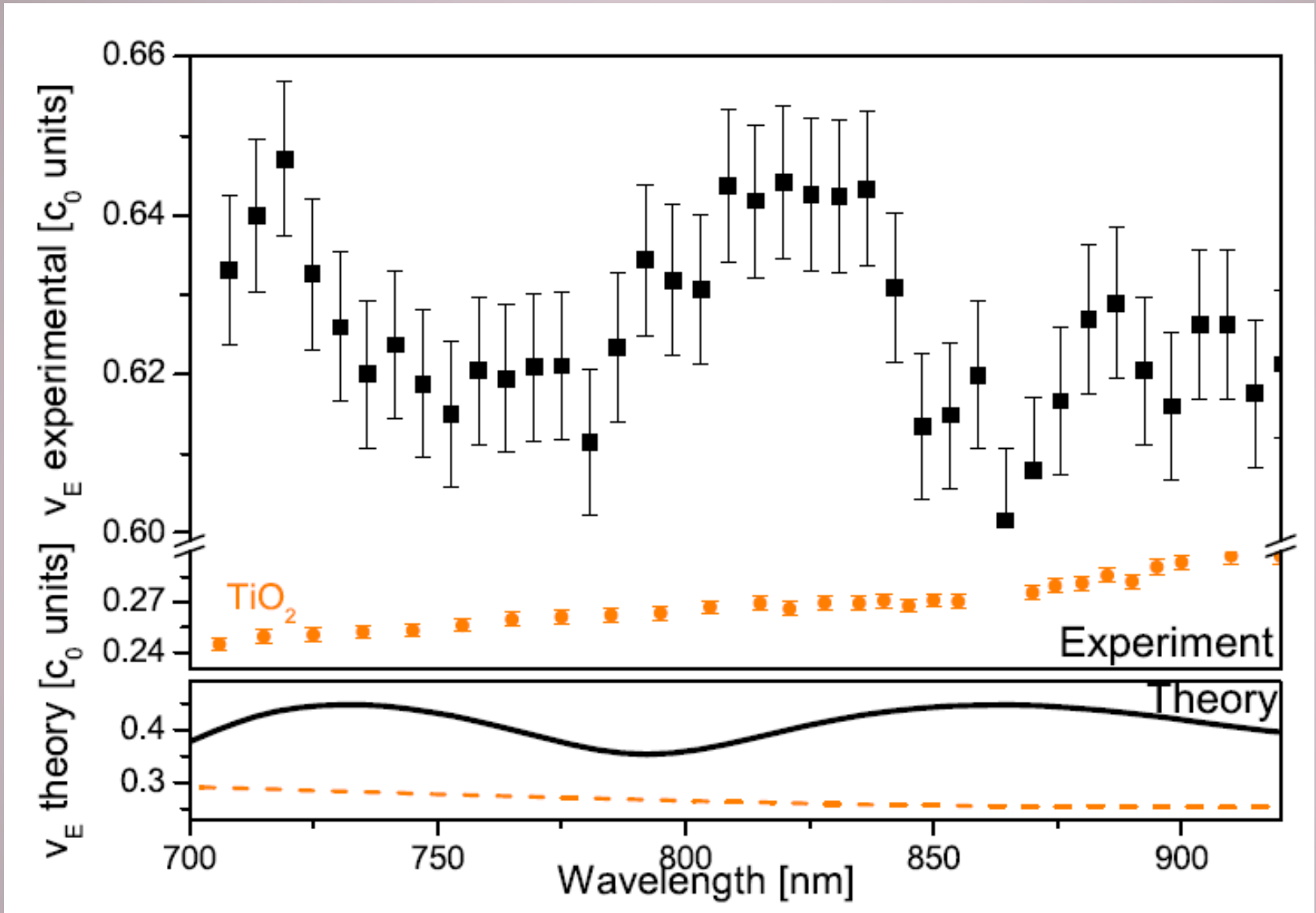


$$\mathcal{D} = \frac{1}{3} v_E \ell_t$$

Dinamic

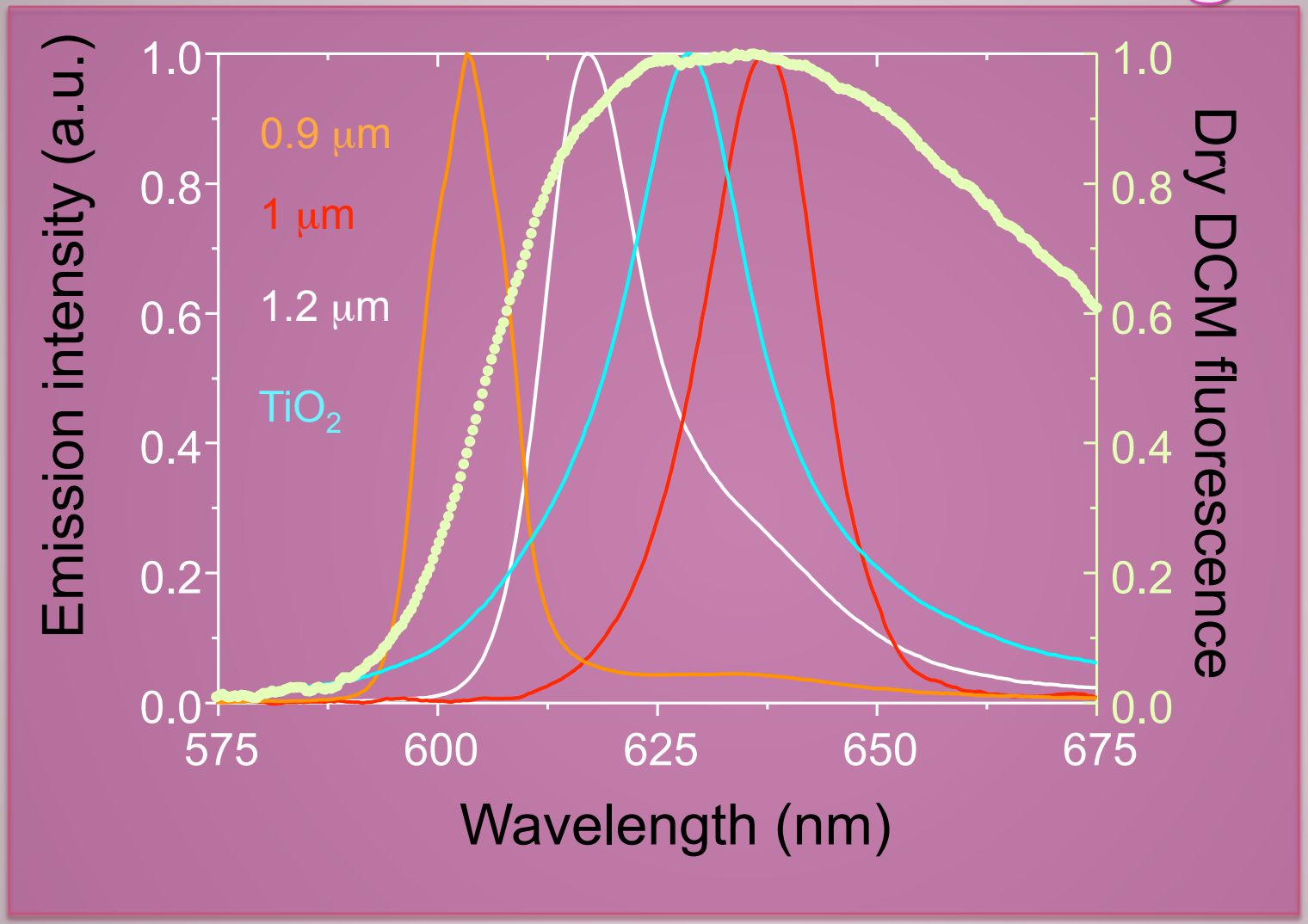






R. Sapienza et al. Phys. Rev. Lett. 99, 233902, (2007)

Resonant Random Lasing



S. Gottardo et al. (Nature Photonics, Accepted 2008)

Conclusions

Stacking faults in thin opal films can be easily identified by simple optical inspection

Resonant Transport in Monodisperse Randomly Disordered Dielectric Media

Acknowledgements

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http://luxrerum.icmm.csic.es/

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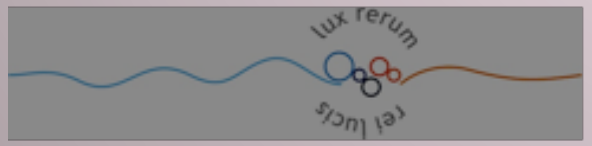
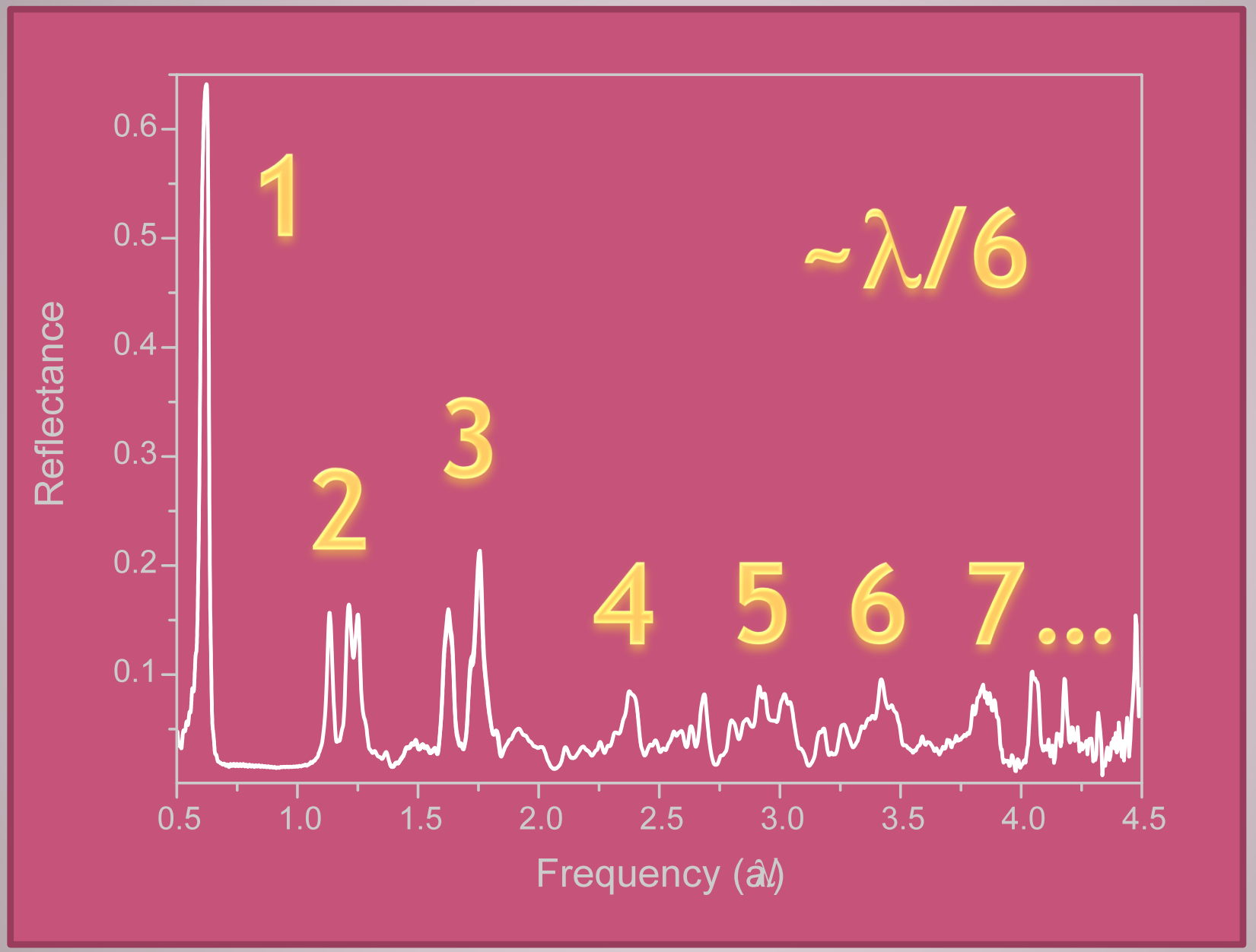
Institut Fresnel, UMR CNRS




1
2
3
4
5
6
7...
~λ/6
Reflectance
0.6
0.5
0.4
0.3
0.2
0.1
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Frequency (a/λ)

Optical characterization

$$\frac{a}{\lambda} = \frac{1.633}{n_{eff}}$$