

Structuration par LASER des Propriétés Optiques Linéaire et Non-Linéaire des Verres

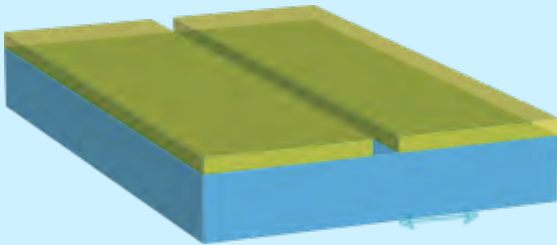
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E. Brasselet, I. Manek-Hönninger, Marie Vangheluwe, Alain Abou Khalil
T. Cardinal, & L. Canioni

 **LAPHIA**
Laser & Photonics
in Aquitaine

 université
de **BORDEAUX**

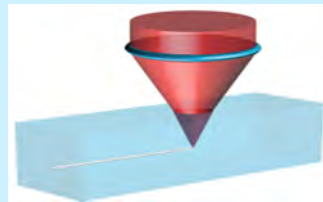
I.a. Towards new 3D photonic structures

Lithography technique



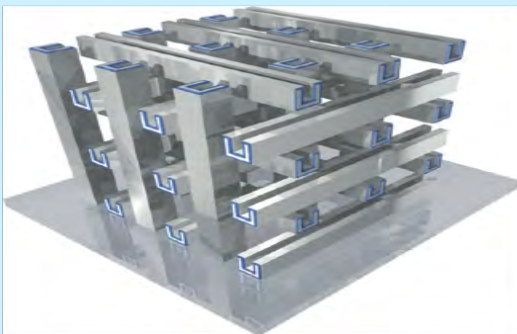
Nanometric but 2D

Femtosecond laser
writing



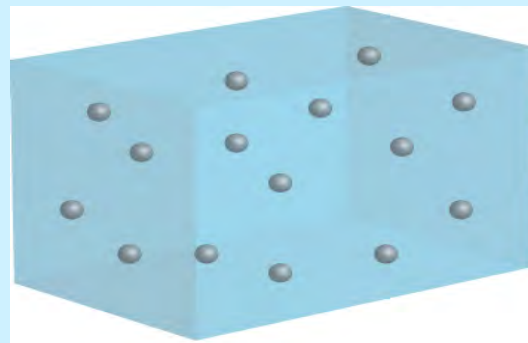
3D but diffraction limited

3D assembling of
2D or 3D structures



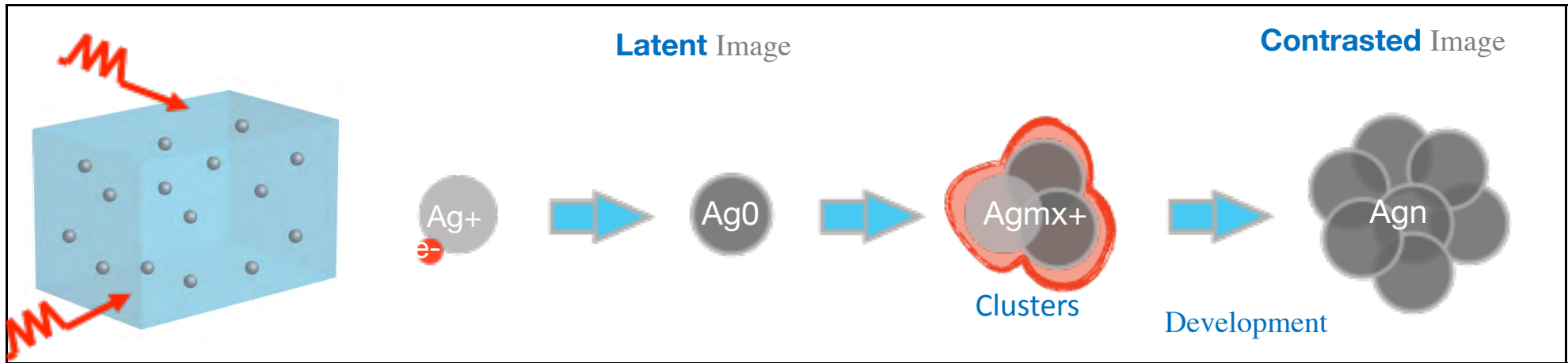
Rilll *et al.*, Nature Materials, 2008

Local development
of architectures in a
photosensitive support

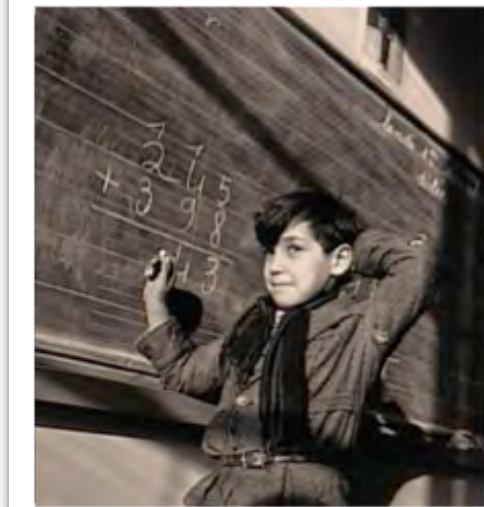


- Evolution to nano-scale structures with multi-scale 3D architectures
- New elementary optical bricks at smaller dimensions
- **new shapes**
- 3D architectures with versatile DLW with **multi-functionalities**

Photosensitive materials: Phosphate glass

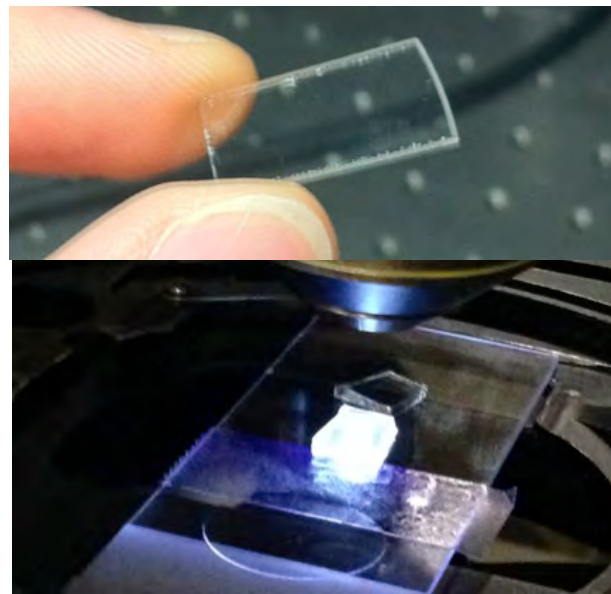


Photographic Film



Doisneau, *Mathématiques*, 1941

Glass Femto-photo-luminescent: **FPL**



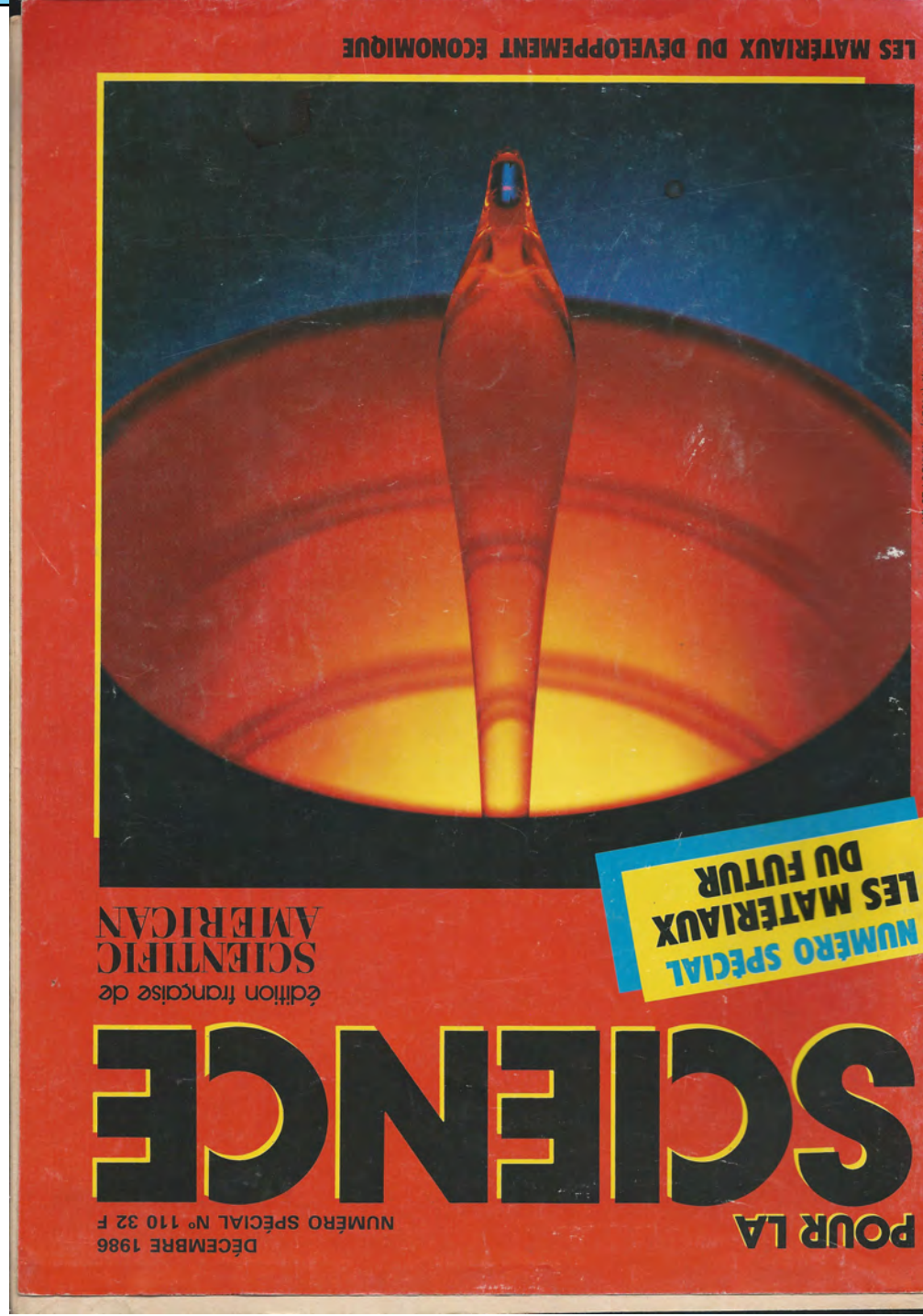
P2O5 / ZnO / Ag₂O / Ga

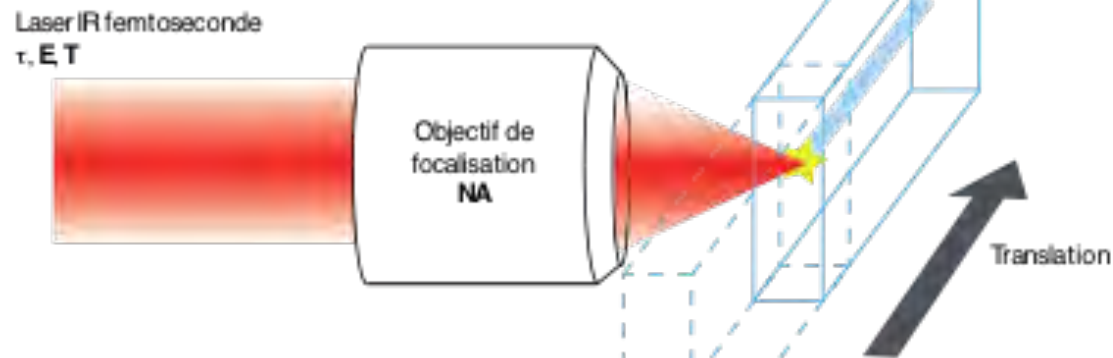
Photosensitive Glass



Stookey, Ind. Eng. Chem., 1949

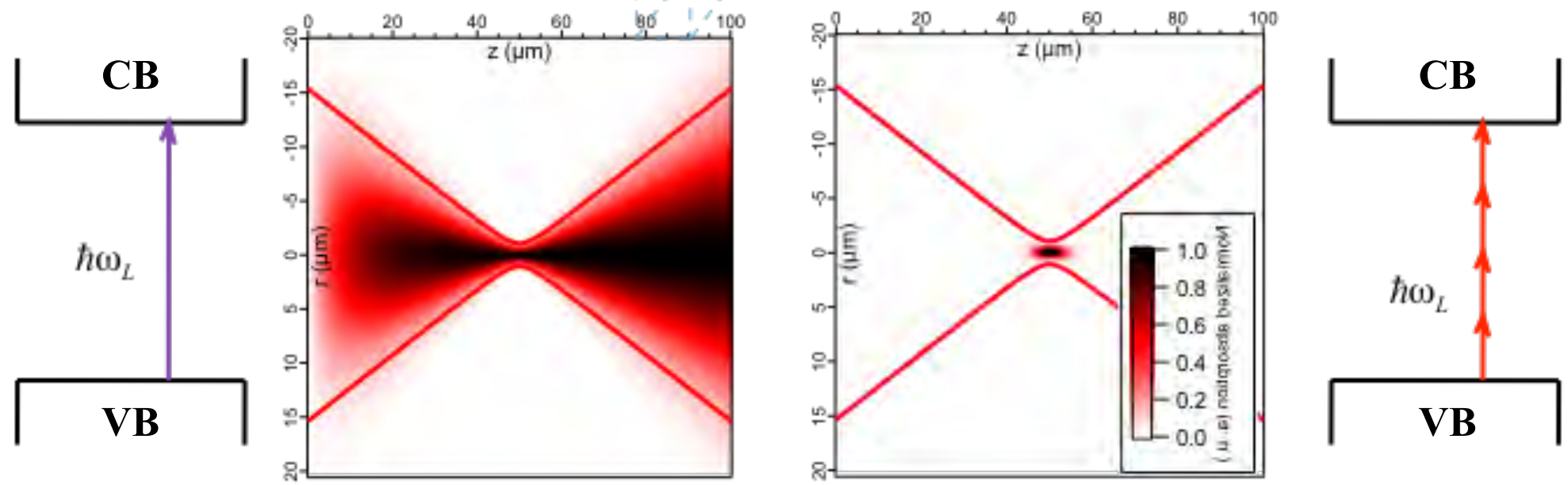
Le verre? Le matériau du futur?



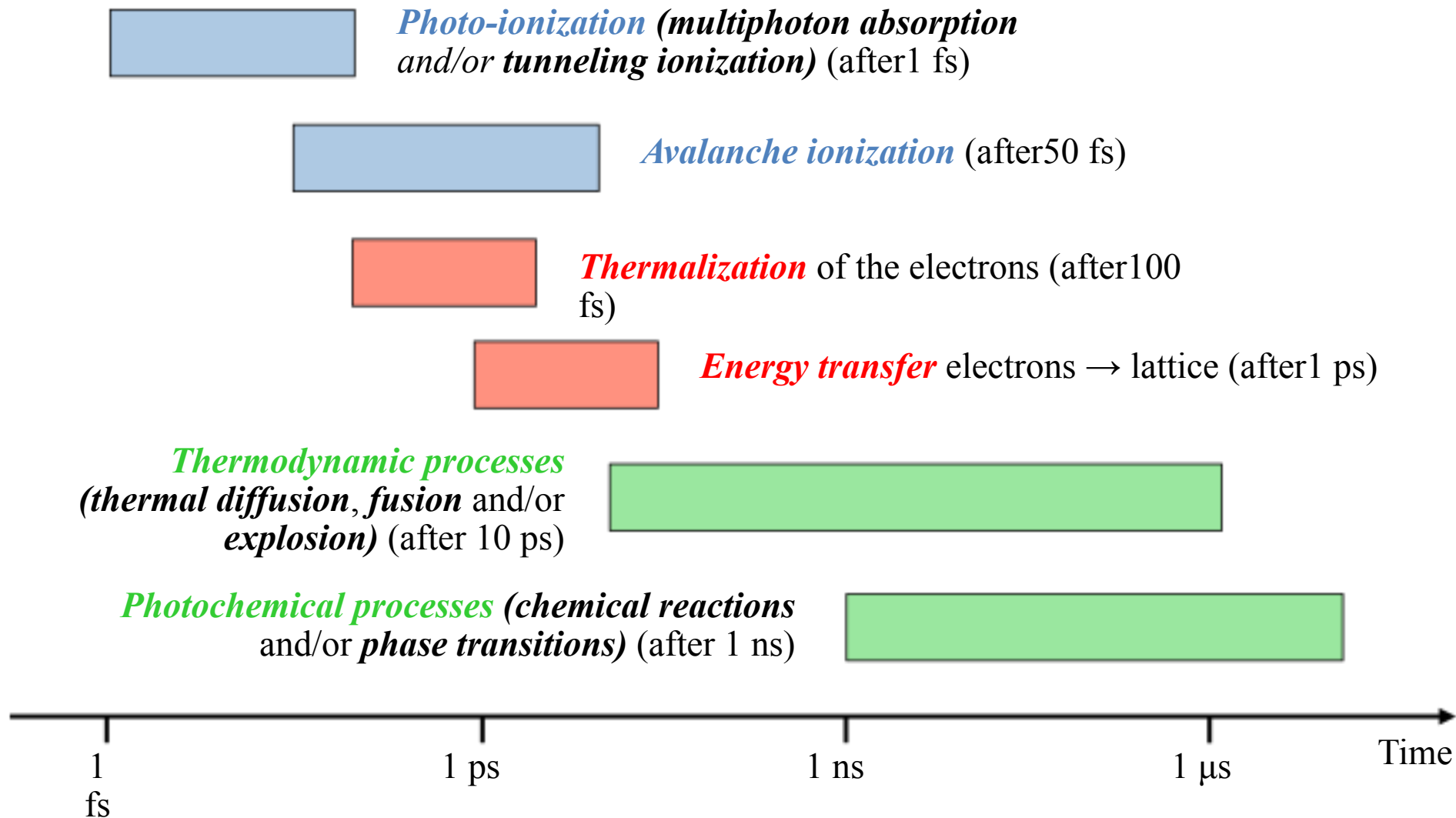


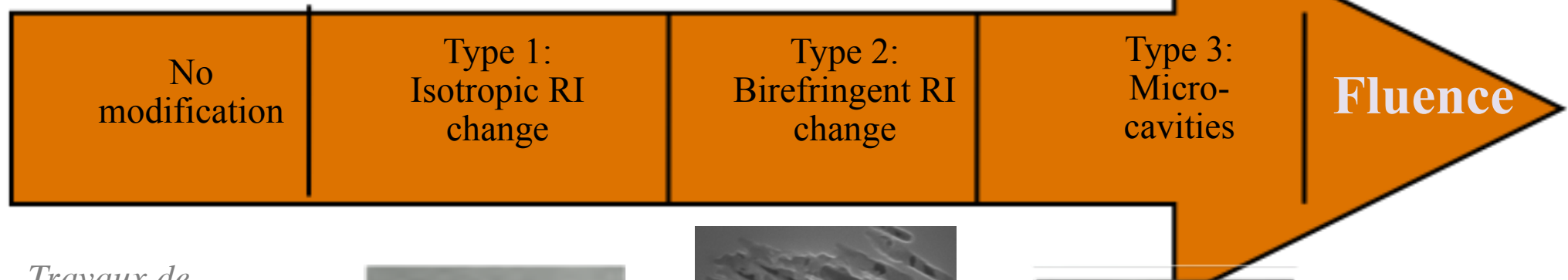
Clef: absorption non-linéaire du laser femtoseconde

Principe de structuration 3D

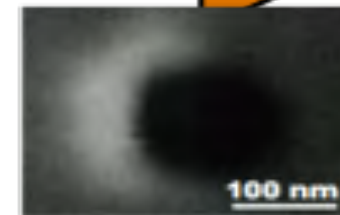
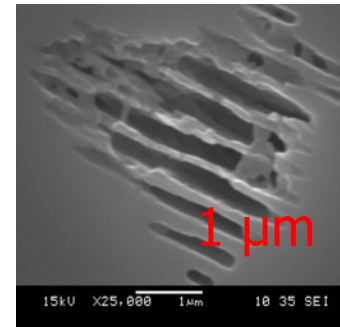
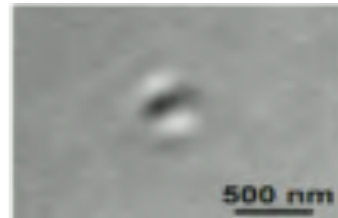


Dépot d'énergie dans un semi conducteur suite à une absorption linéaire gauche et non-linéaire à droite





Travaux de Kasansky, Corkum, Nolte, Scheffer, Royon..



Modification d'indice homogène



Guide d'onde

Modification d'indice anisotrope



Polariseur

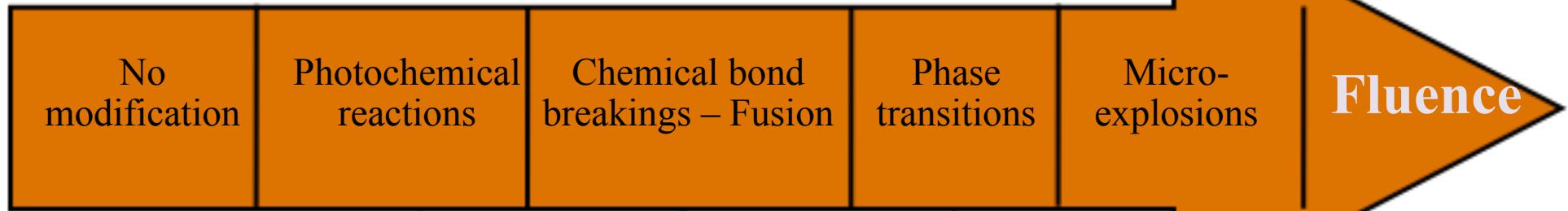
Micro-explosion



Stockage

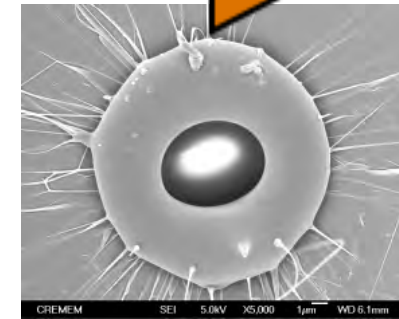
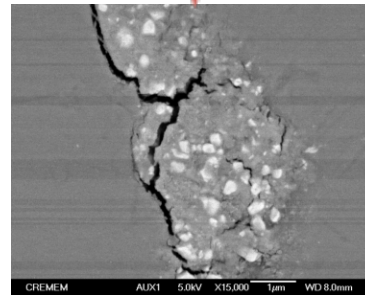
La structuration dépend fortement de la fluence (J/cm^2)

Exemple de structuration de matériaux vitreux

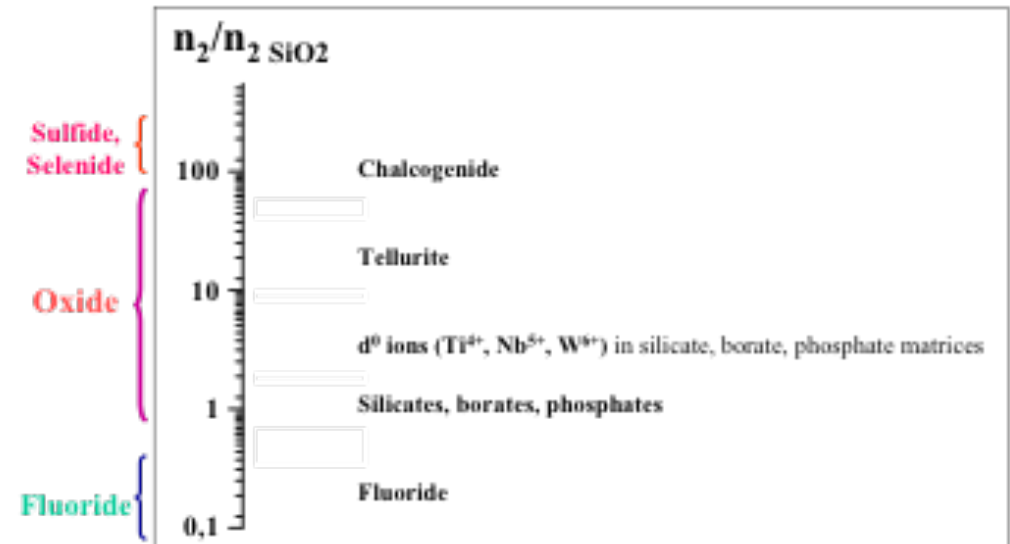


Wave guide writing
In oxyde glasses and chalcogenide (SiO₂, phosphate, As₂S₃...)

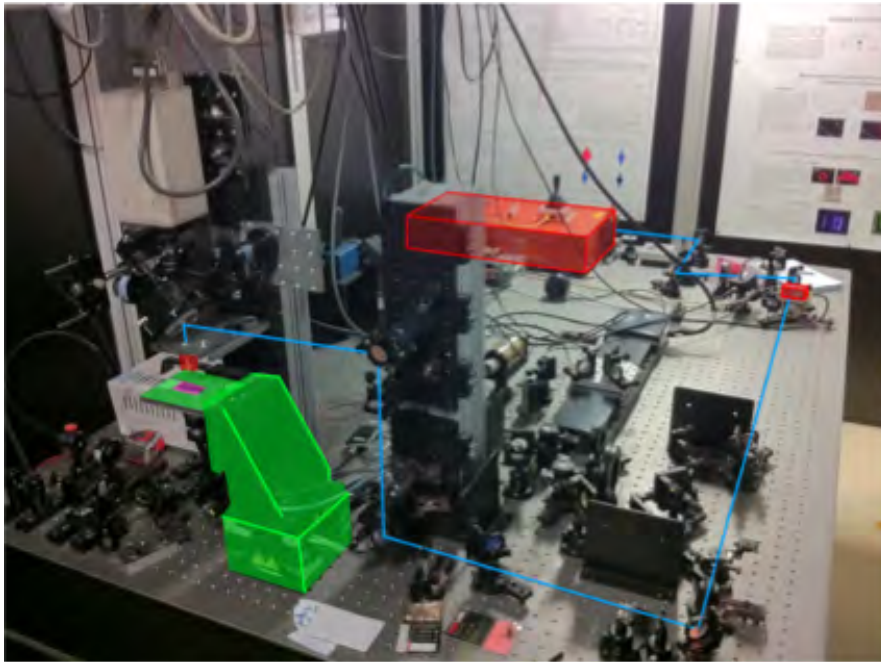
Photo expansion After irradiation



Les grandes familles de verre et l'échelle des non- linéarités

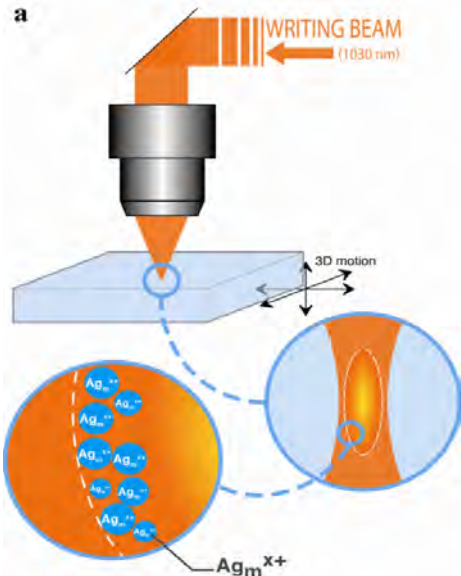
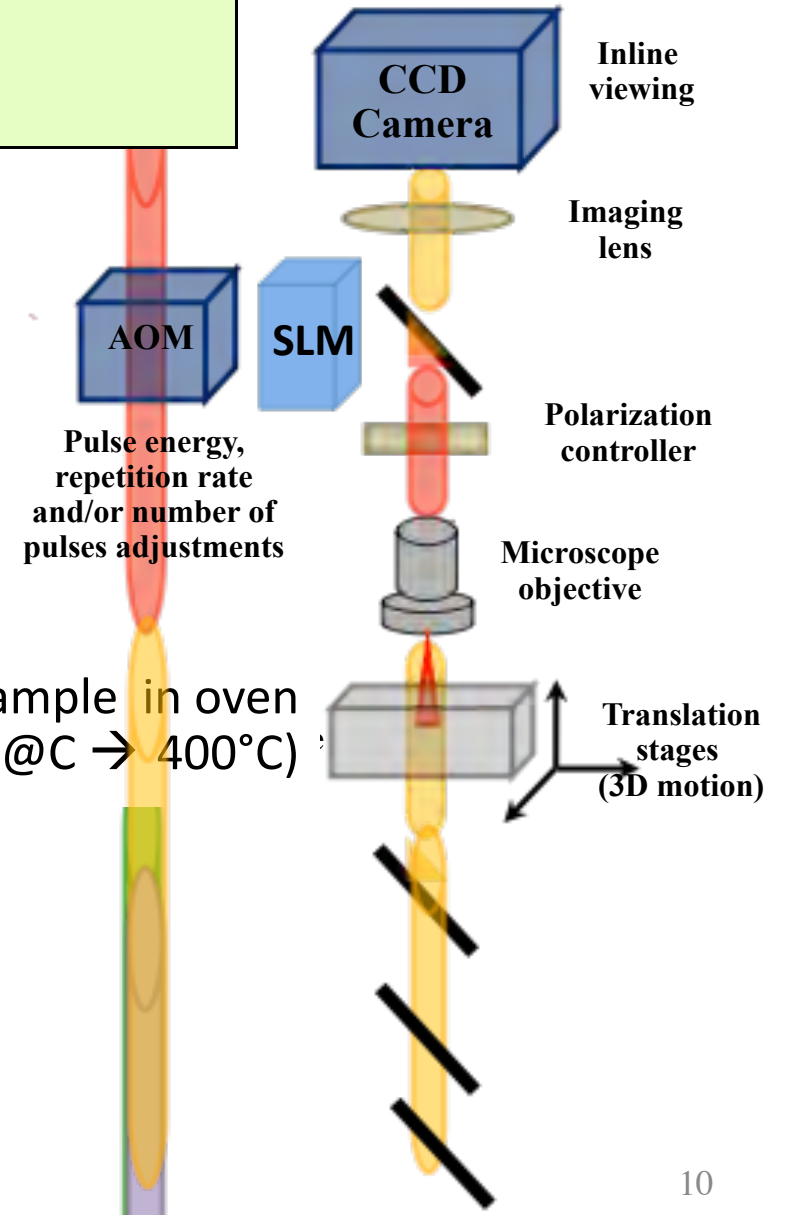


1. **Caractéristiques de l'inscription directe laser**
2. La photo-excitation
3. Effets d'accumulation, diffusion, thermo-élastiques
4. Propriétés non-linéaire second ordre
5. Post Traitement thermique



Duration 390fs @1030nm
NA: 0.2 → 1.3
En: 0 → 400 nJ
Frep : 0 → 10 Mhz

Femtosecond laser
High repetition rate



Royon *et al.*, Adv. Mat.
DOI 10.1002/adma.201002413 (2010).