Saint Gobain: 356 years of science and technology…

Yves Bréchet

Scientific director of SG
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SAINT-GOBAIN

Who is this guy ?

Born in 1961
Ecole Polytechnique (X81),
PhD in materials science (Grenoble 1987), Habilitation in Materials Science (1992)

Professor in materials science in Grenoble University (1997-2012)
Adjunct professor in McMaster University (Canada), Jiaotong University(Shangai-China), Distinguished research professor in Monash (Autralia)
Prof College de France (2012-2013) : Innovation and technology chair

Member of French Academy of sciences (2010) European academy of Sciences, Academia Europea

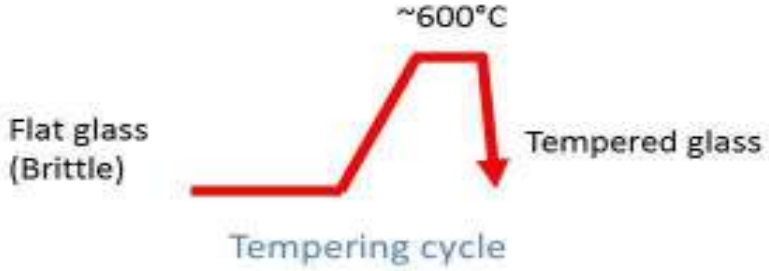
Scientific advisor to the french government (« Haut commissaire à l'Energie atomique » (2012-2018))

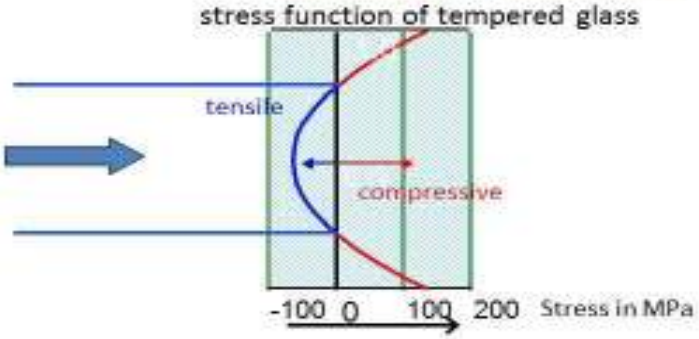
Scientic Director of Saint Gobain (2018-…)

Where metallurgy meets glass…

➢Tempered glass:

- Application: glazing for building
  (esthetical and transparency)
- **Advantage: better resistance to brittleness**



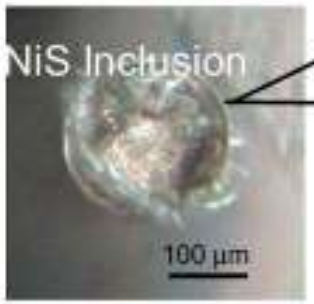


➢Inclusion in glass:

- ➢ Origin of impurities: raw materials, handling and transport
- ➢ Nickel sulphides: non soluble in the vitreous matrix➔ inclusion
- ➢ Rare: 1inclusion/300m² (size : 50-600µm)
- ➢Metastable

Nickel Sulfides inclusions & delayed fracture of tempered glass

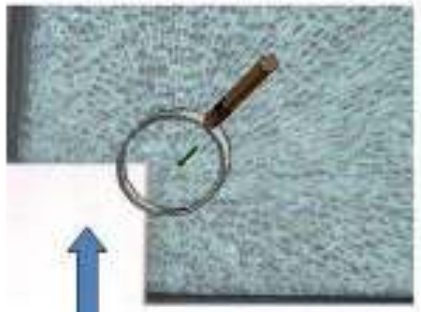
- Mechanism : In tempered glass NiS inclusion + phase transformation → fracture!!

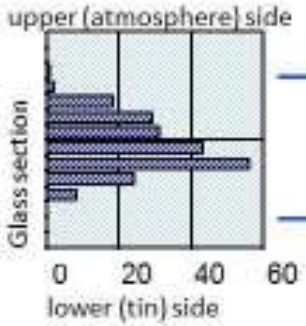


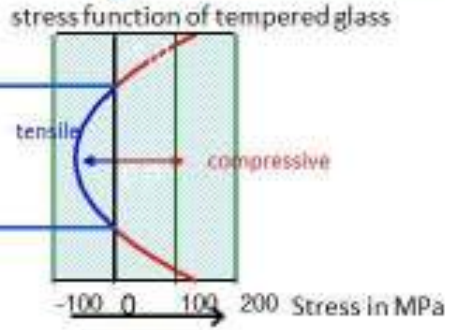
α: Hexagonal

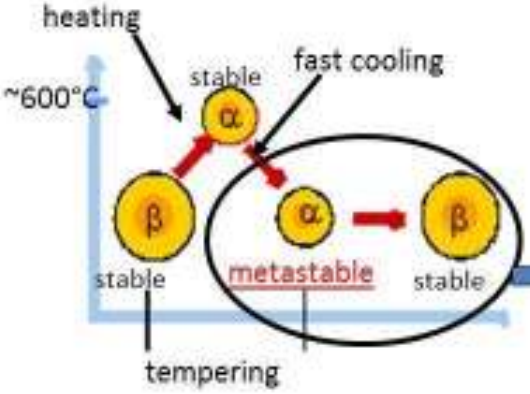
β: Rhombohedric

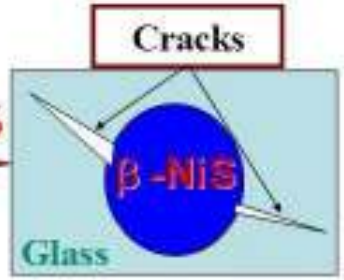
???????











A compagny with an history and a future…

- Rooted in history
- Infused with Science
- Responsible for the future

A Very old story….

Louis XIV (1638-1715) and Versailles

Manufacture royale des Glaces, Saint Gobain… 350 years ago

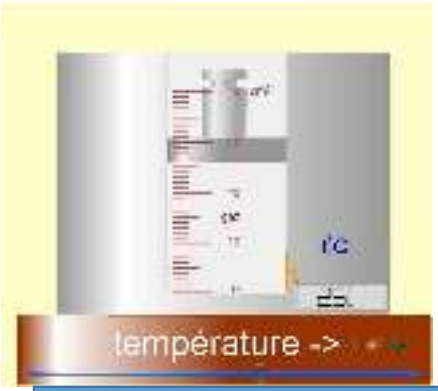
A lasting commitment with science...

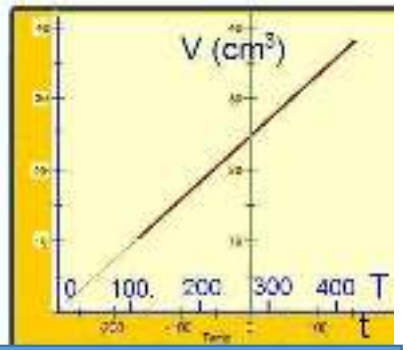
Gay-Lussac as a scientific director of Saint Gobain…

Gay Lussac and Saint Gobain…

- 1815-1839 : progressively more and more interested in applications of science (Explosive Chemistry, Mint metallurgy…)

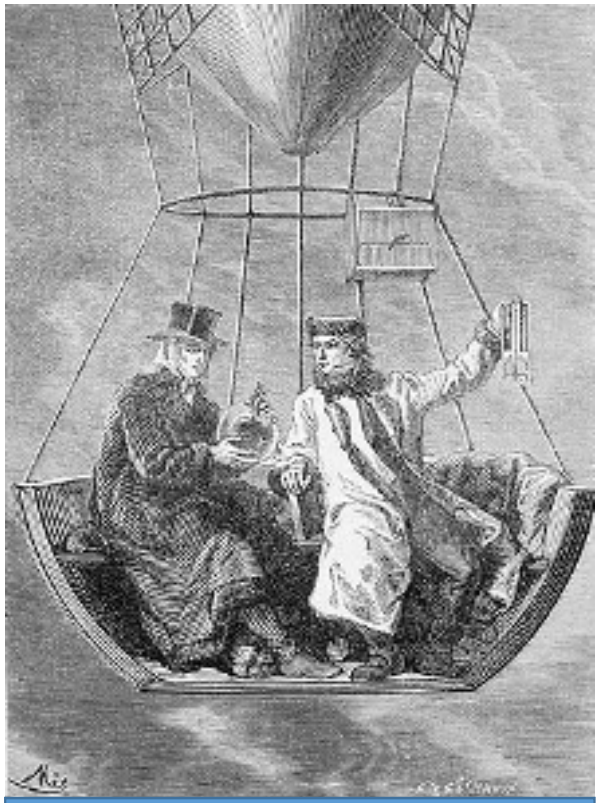
- 1830: Saint Gobain becomes a society with stake older and a Board. 5 members, 2 censors
- 1832: Gay-Lussac becomes a « censor » (=Scientific advisor)
- 1834: detailed visit of Chauny
- 1835: The Gay Lussac process
- 1840: full member of the board
- 1843: President of Saint Gobain (with no management responsabilities)





Charles and Gay-Lussac law for gazes

Measure of alcool content in beaverages



Temperature, Pressure, Magnetism…

How did Gay Lussac came from Alcool content measurements to Saint-Gobain ?

…

Via his studies of acids !
Sulfuric acid necessary for producing sodium carbonates

Saint Gobain today...

Saint-gobain KEY FIGURES

- More than
- **75%**
- of sales are made in the habitat markets

- One of the top
- **100**
- industrial groups in the world with around 950 production sites

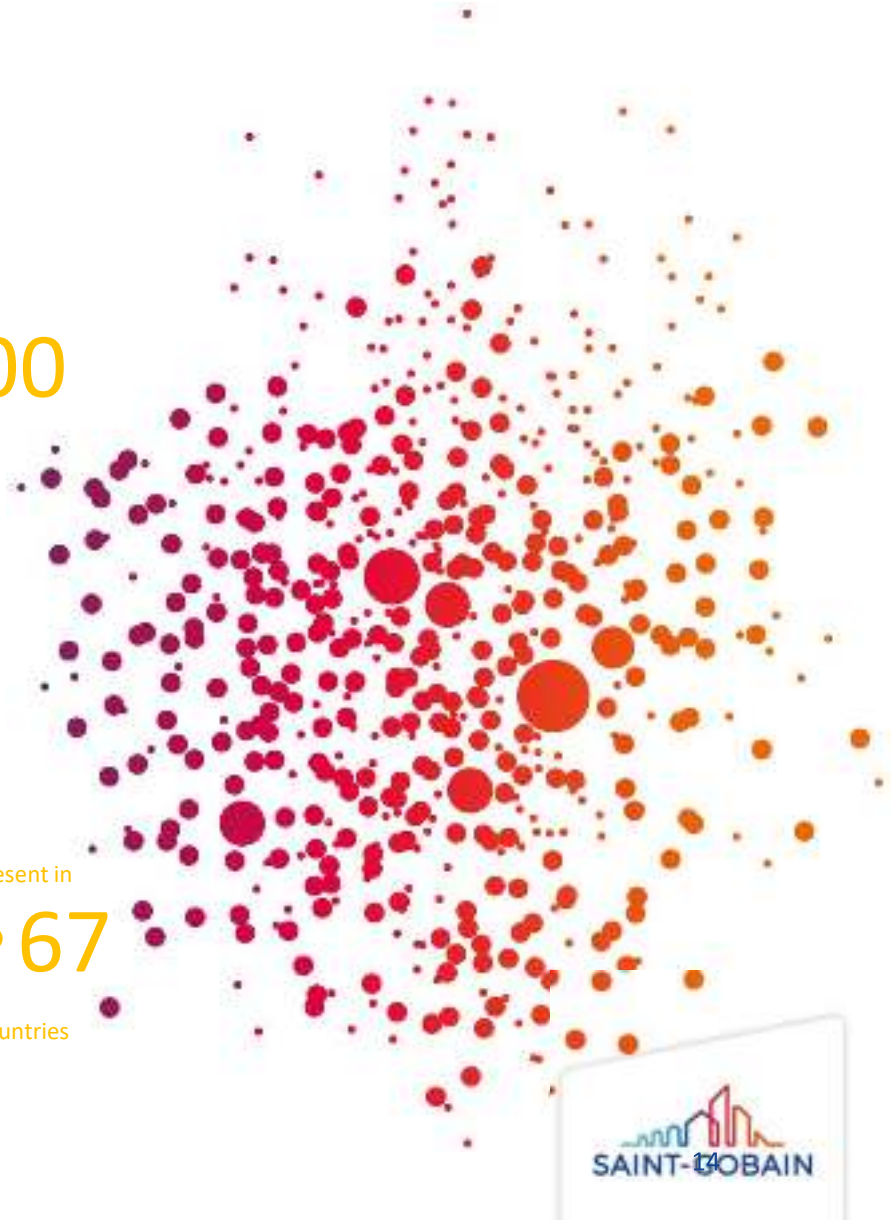
- More than
- **4,100**
- sales outlets

- 2017 net sales
- **€40.8 BN**

- More than
- **179,000**
- Employees and 100+ nationalities represented

- Created more than
- **350**
- years ago

- Present in
- **67**
- countries



SAINT-GOBAIN, RANKED AMONG THE TOP 100 GLOBAL INNOVATOR*

2018 TOP 100 GLOBAL INNOVATOR Clarivate Analytics

About **100** development units worldwide

3,700 researchers

USA 21%

Europe 61%

Asia 14%

other 4%

1 in **4** Saint-Gobain products sold today did not exist five years ago

8 Transversal R&D centers

400 patents filed in 2017

28.5 % of women

446 in million €

Research and development costs booked

* Clarivate Analytics "Top 100 Global Innovator" 2017 ranking

8 TRANSVERSAL R&D CENTERS

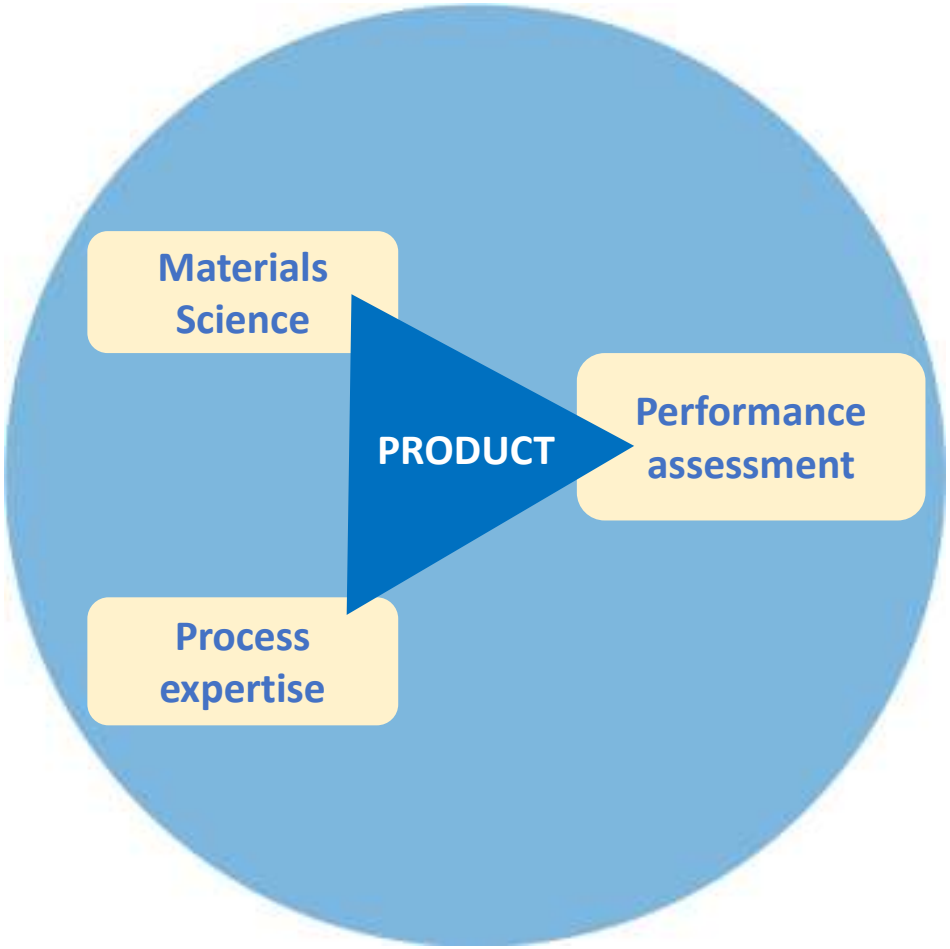
Individually and as a network:

- Maintain/develop core technologies at top level
  + add new ones
- Host large projects
  & exploratory programs
- Innovation Showcases
  for our customers
- **Hubs for academic/external contacts**
- Places to attract, develop talents

OUR CORE

Glass, gypsum, cement,
cast iron, alumina, zirconia, SiC,
polymers, binders ..

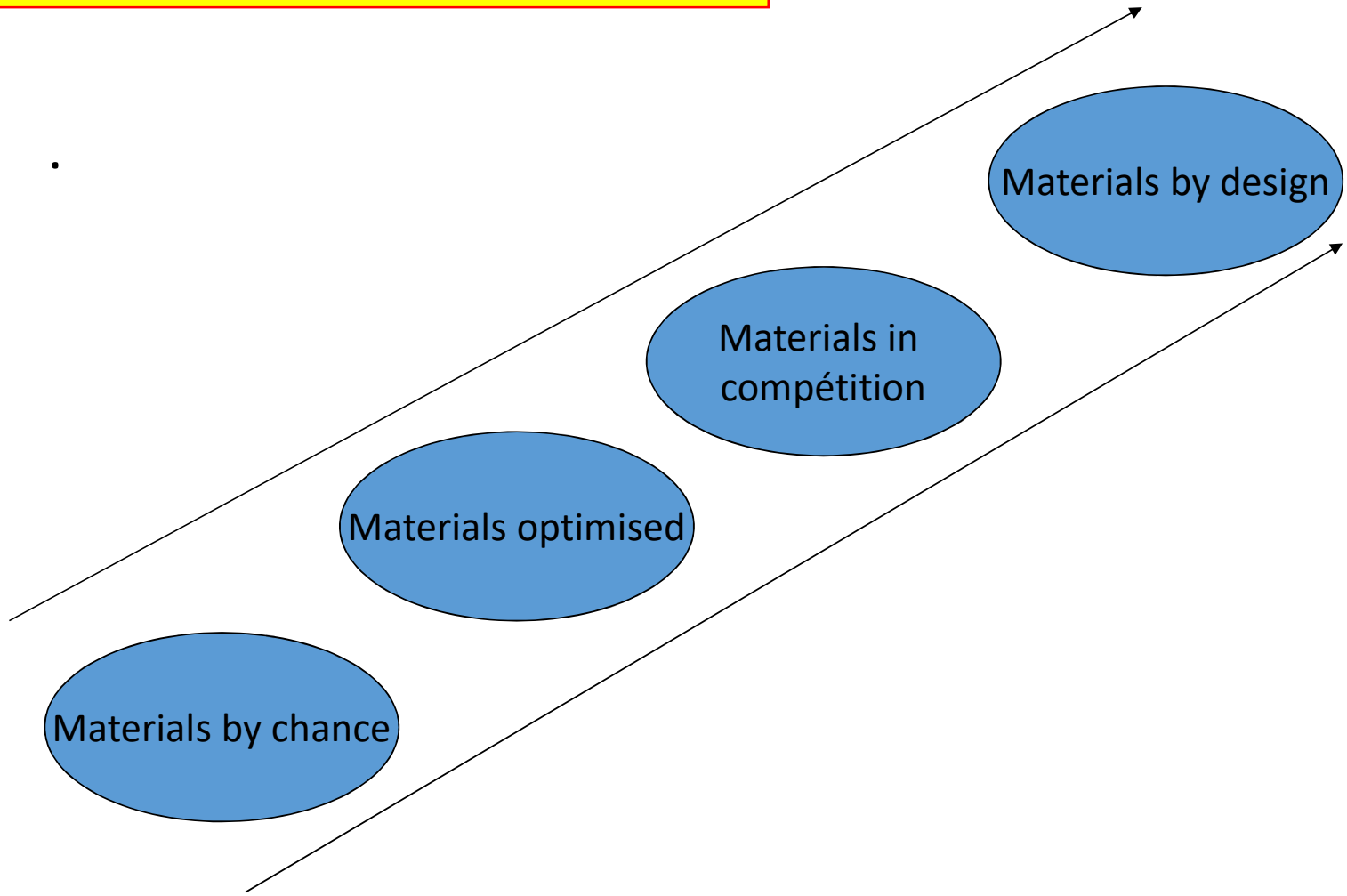
Furnacing, calcination, fiberizing,
casting, pressing, ovens, lamination,
coating, knitting, mixing, grinding, ..

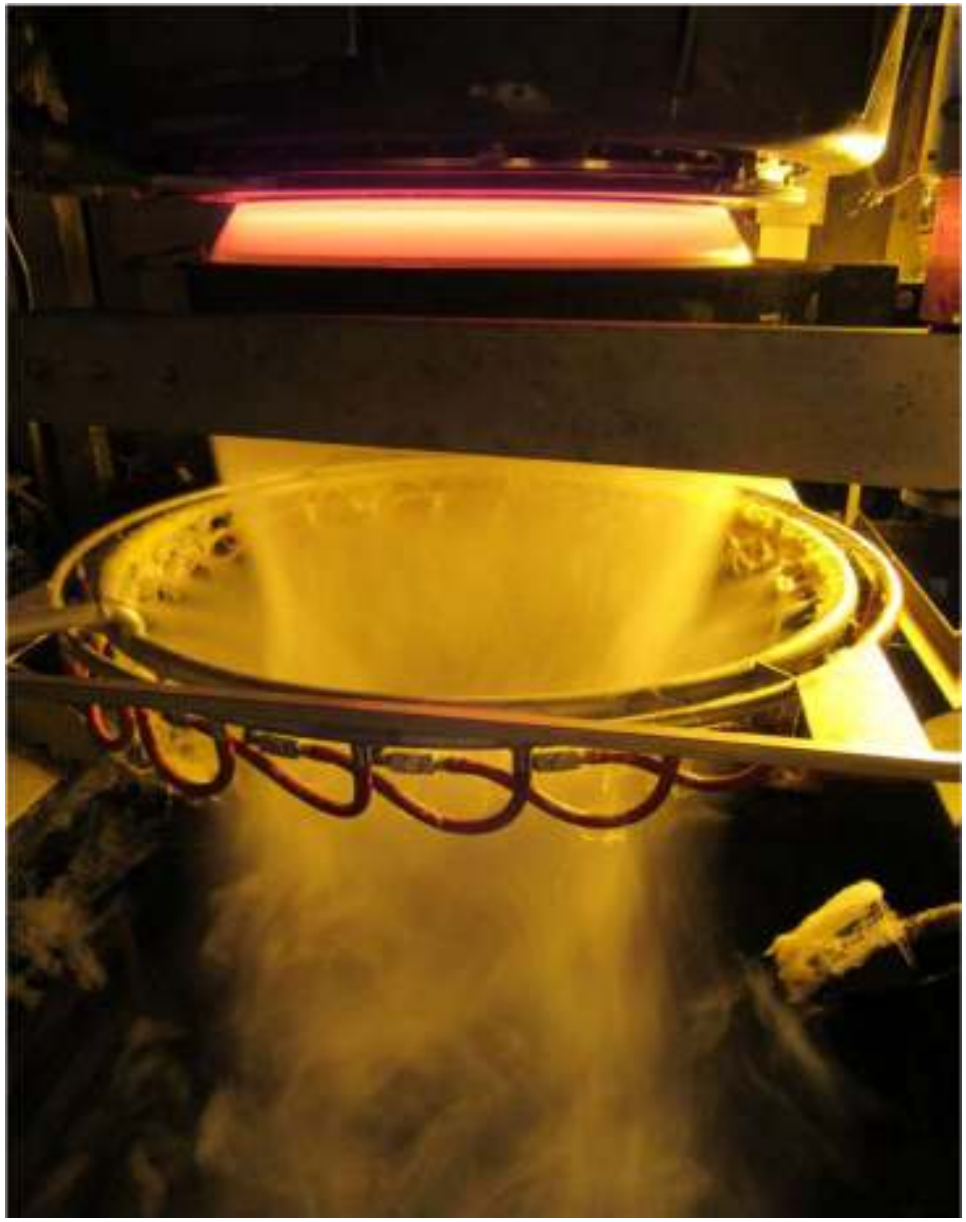


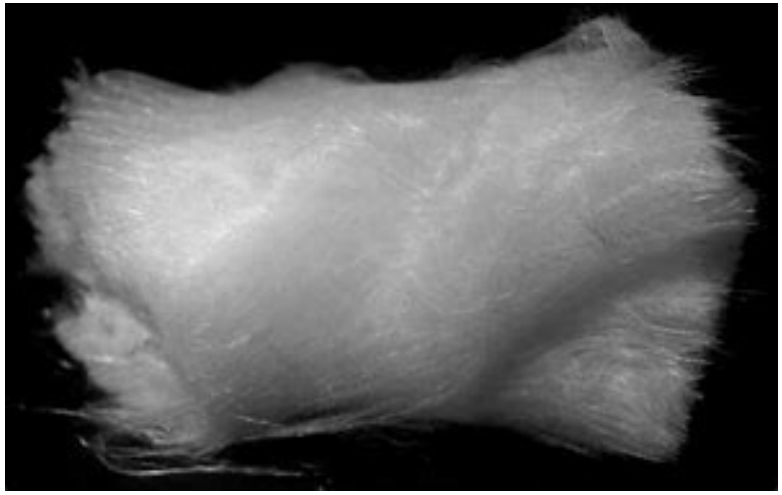
Mechanics (strength, elasticity, friction adhesion, ..), optical properties, thermal insulation, corrosion resistance, High T stability, …

Mechanics, Materials Science, Physics, Chemistry, Optics, Mathematics, Engineering

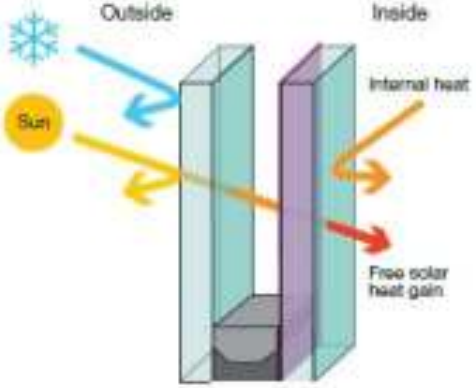
A MULTIMATERIALS MULTI-APPLICATION COMPAGNY

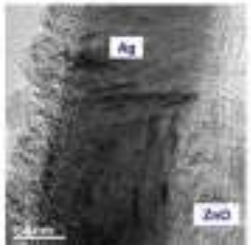


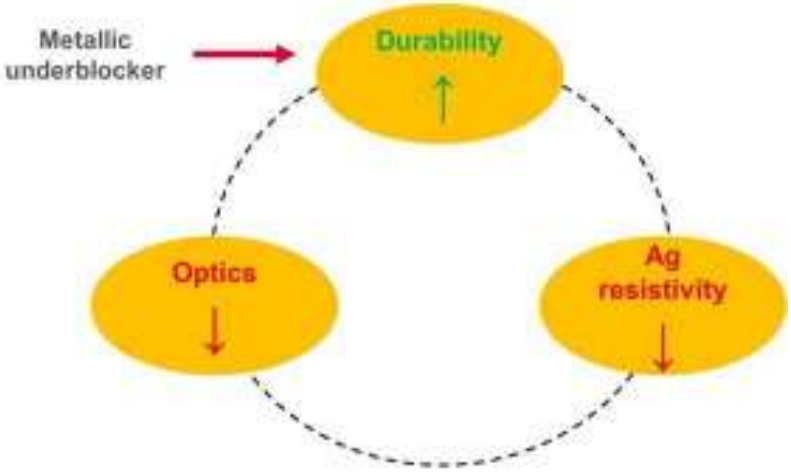




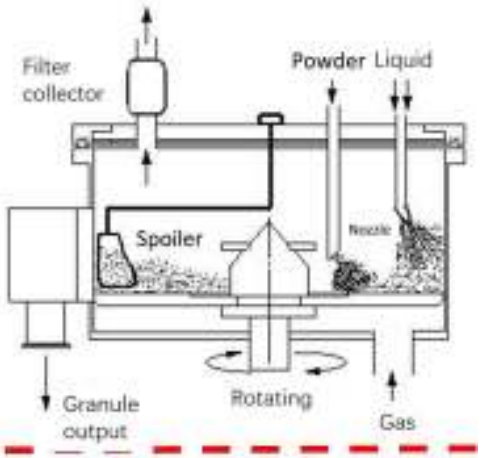
- Three main issues in Ag-based stacks for glazing:
  - Ag resistivity (emissivity)
  - Mechanics
  - Optics
- Trade-off between these properties, most of the time







From Fine Powder to Millimeter-scale Granules



Nucleation

Seed Growth

Granule Size

Raw material powder

0.02 mm

0.04 mm

Nucleation
Seed formation

0.09 mm

Layering and growing
Low sphericity

0.20 mm

0.30 mm

0.40 mm

0.50 mm

Granule growth
Larger - High sphericity

0.60 mm

0.70 mm

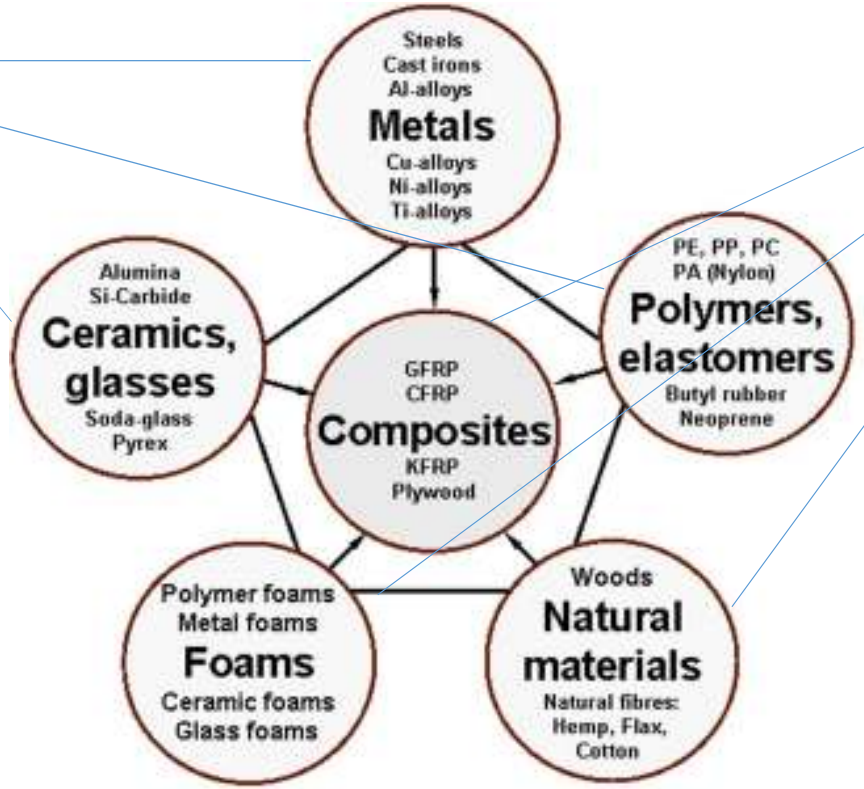
1.00 mm

Granulation Time & Powder Feeding amount

Materials Families + architectured materials

Composition , microstructure Defects

Geometry, Topology Association



CLASSICAL MATERIALS

Model for the Relations Process/microsctructure/Properties

Downscaling toward atomistics

« Materials genome strategy »

ARCHITECTURED MATERIALS

Models for the geometry, for the interface behaviour, for global functionnal properties

Upscaling toward componant

Saint-Gobain has an history and is looking responsibly toward the future…

COMMITTED TO FIGHT CLIMATE CHANGE WITH ENGINEERED SOLUTION

Improving thermal insultation glazings

finding more efficient building insulation

Decreasing CO2 emission in processes such as glass making and gypsum calcination

CO2 capture and mineralisation