

SPCD
ESA / ESTEC
10/10/2018

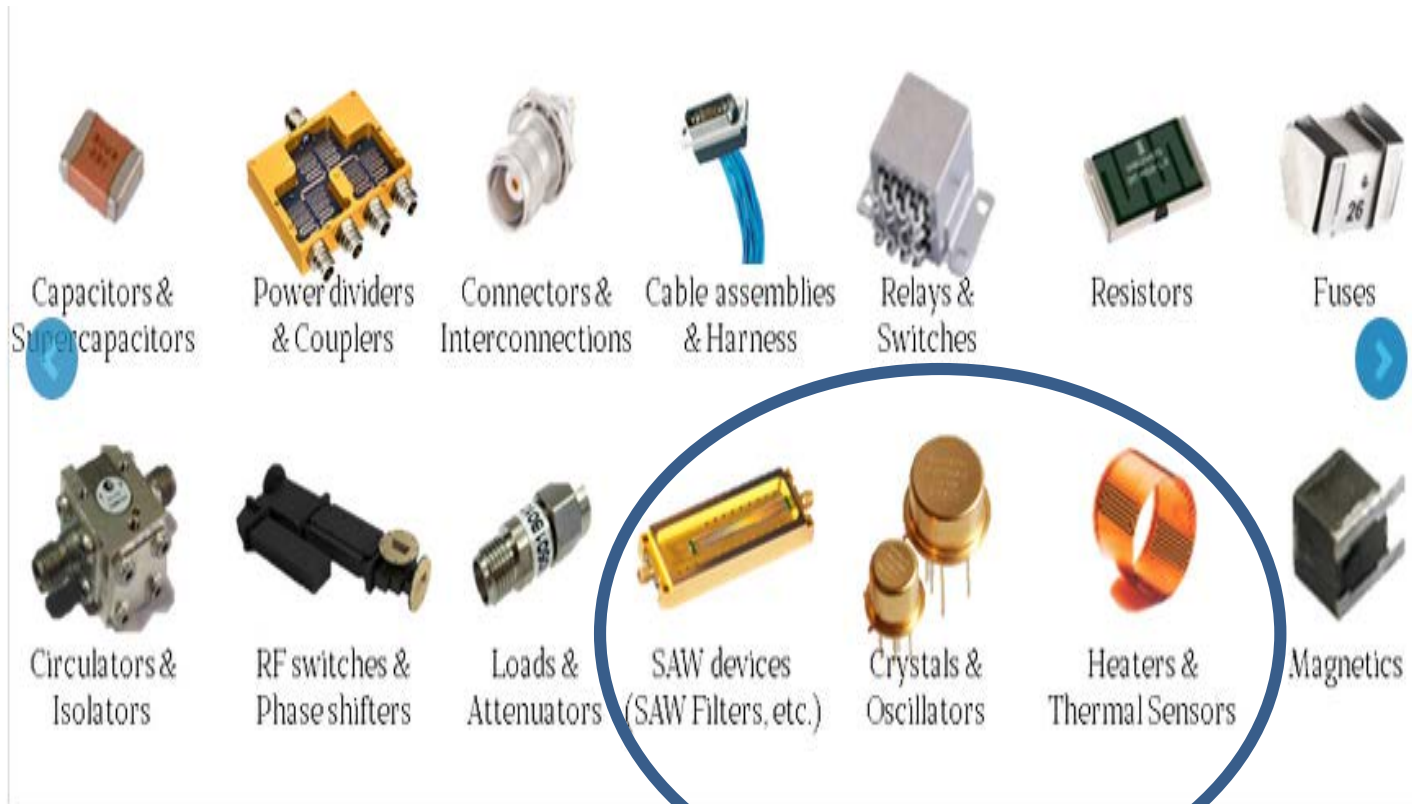
Quartz and
piezoelectric substrates
for space components

Presentation outline

- 1_ Piezoelectric materials for space components
- 2_ Risk of HQ Quartz crystal supply in Europe
- 3_ Cristal innov : a good place to restart Quartz synthesis for space application
- 4_ Specifications and characterisations
- 5_ Potential for components : focus on BAW and SAW devices
- 6_ Other piezoelectric crystal with high potential for innovation in space : LGx
- 7_ Roadmap and Outlook

1_ Piezoelectric MATERIALS for space components

A important issue



2_ High Quality Quartz suppliers

situation in Europe

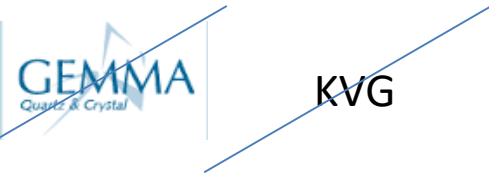
high quality quartz for space application :
a niche market, but competitive

=> Main European Quartz suppliers have stopped manufacturing this crystal



⇒ Risk for strategic supply chain

⇒ Lack of flexibility for collaborative innovation



Need for raw material European non-dependance

The French defense and space agencies (DGA & CNES) and Cristal innov entered into discussion in 2014 to restart a high quality quartz production based on an innovative process.



High Pressure Autoclave for hydrothermal synthesis



Quartz crystal

Start of the project : 2015

3_ Why in Cristal innov

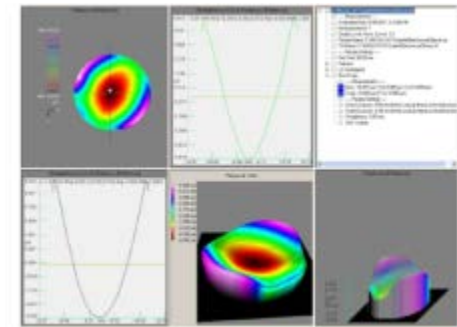
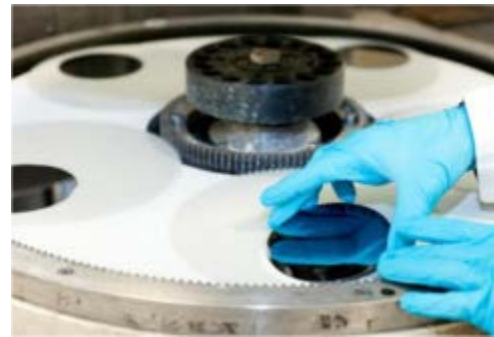


A European technology center for innovation in crystal growth and procee

Different growth technologies and equipments

Cutting / wafering / Lapping / surface preparation

Characterisations



Example :
Ti:sapphire growth
process development



Capabilities from crystal growth to substrate

4_ High quality quartz crystal for high performance

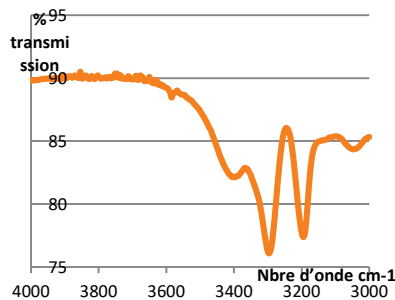
Characterisation

High purity Quartz crystal hydrothermal synthesis



Qualified protocol characterisations

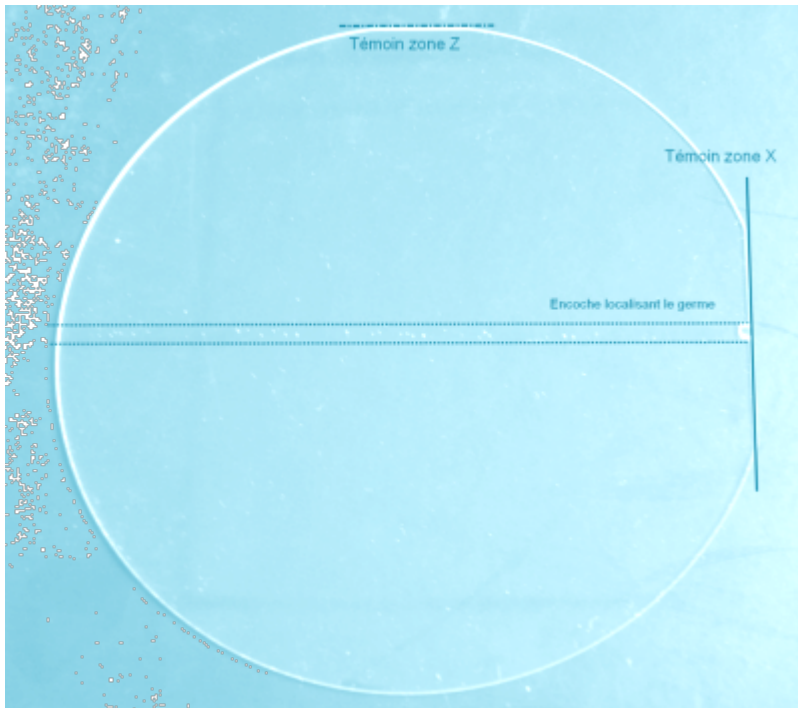
Quality criteria	High quality
<ul style="list-style-type: none">• Infrared absorption α 3500cm-1• Inclusions• Dislocation density• Etch channels• Elemental impurity	<ul style="list-style-type: none">• $\alpha < 0,026$• Grade Ia• Grade Ia $< 5/cm^2$• Al, Fe, Na, K, Mg, Ca $< 1ppm$; Li $< 0,1ppm$



For BAW and SAW devices

Substrate for resonator

Specification target:



Blanks and Wafers : SC, AT, Z cut

Dimensions: up to 3"

Thickness: 250 / 380 / 600 μm

Simple or double face polished

Ra < 6nm

Bow : tbd

Flatness : tbd

Rings : up to 15mm diameter \pm 0,01mm

6_ Other piezoelectric crystals For severe environment

⇒ No phase transition up to the melting point (about 1450°C)
Applications :
◆ High temperature sensors (600°C)
◆ High Q (similar to quartz)

HIGH TEMPERATURE
RESISTANT CRYSTAL



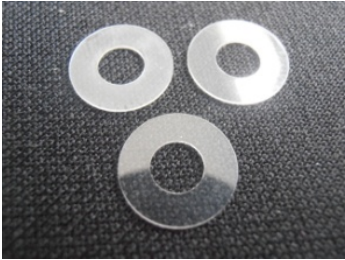
SENSORS

SAW
Resonators

Piezo direct
effect sensors

Ex : Langatate (LGT)

Substrate for
SAW sensors
in severe
environment



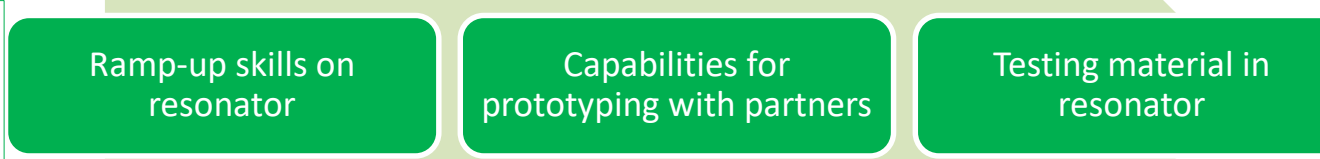
LGT rings for High Rel
Accelerometer
up to 600°C



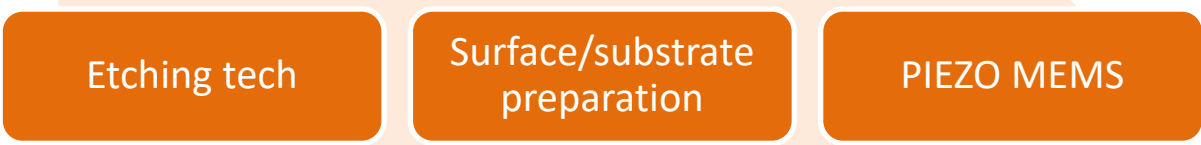
material



Character° on resonator



Innovative process



cluster



www.cristalinnov.com

7_ Conclusion : a potential for a European cluster for competitiveness and maintaining HQ Quartz production

→ TIME & FREQUENCY PRODUCTS

- Quartz Oscillators (XO / TCXO / OCXO)
- Ultra Stable OCXO (QAS resonator):
- Higher Frequency

→ PIEZOELECTRIC SAW DEVICES

- Piezoelectric Filters (BAW / SAW)
- RF Systems

→ TELECOMS APPLICATIONS

- Radiocommunication / Satcom
- Radionavigation
- Radars
- Electronic warfare

→ MATERIAL MAIN CHARACTERISTICS

- High stability
- Low phase noise under vibration
- High reliability under radiations



THANK YOU FOR YOUR ATTENTION

Questions during lunch time 😊