

Improve packaging reliability of **Electronics** **and Optoelectronic Devices** through **advanced materials**

M. Moraja,
SAES Getters S.p.A., Italy

EPIC Meeting on New Space at European Space Agency
Noordwijk, The Netherlands, September 13 2019



making **innovation happen**, together

SAES Group: a condensed Identikit

An Innovative R&D based Company

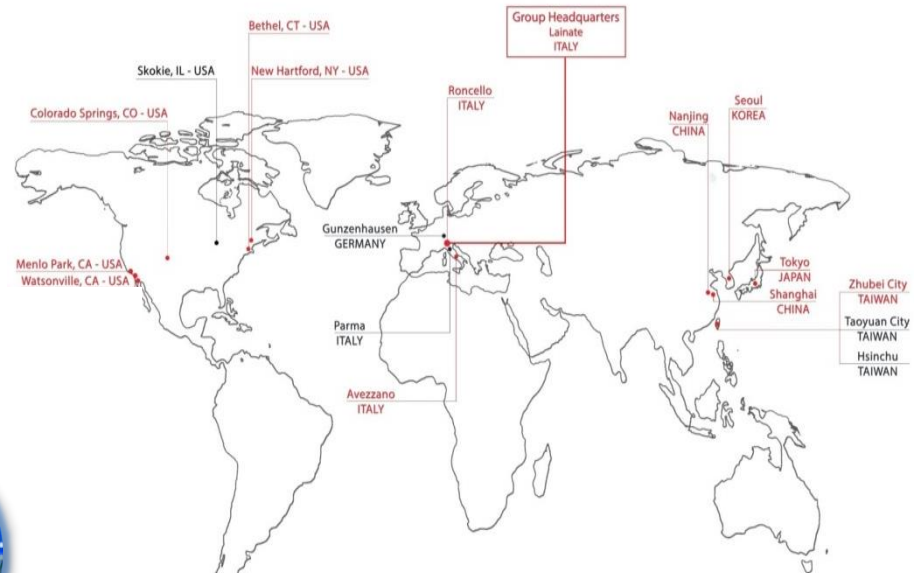
- SAES Group is an **advanced materials** company
- Company Headquarters in Italy (Milano) and 10 production sites worldwide:
 - ~ 1000 employees; ~ 172M€ (2018)
- The Group, 70 years old, invests each year about 8% of the revenues in R&D.

Key Areas and products

- Active advanced materials: getters, dryers
- Getter Pumps
- Nitinol-based Shape-Memory products
- Functional polymer composites



Global Presence

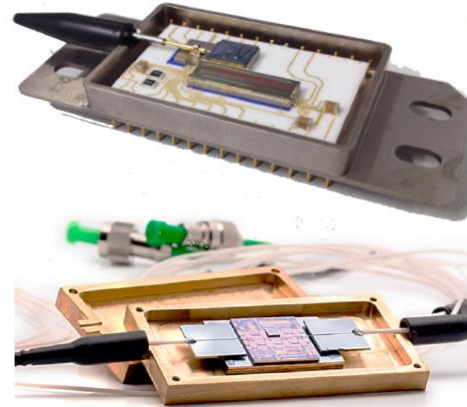


Main Final Markets

- Consumer Electronics
- Automotive
- Advanced Packaging
- Healthcare
- Security & Defense
- Telecom, Data transmission, Optoelectronics

- Packaging of Photonic devices
- Issues related to gaseous contaminants in packaged devices
- Advanced solutions to capture the contaminants: getters
- Conclusions

- Proper packaging is a key-step to obtain good quality photonic devices: optical, electrical, and thermal needs require important efforts to assure performances and reliability of the systems



L.Carroll, P.O'Brien et al. *Appl.Sci.* 2016, 6,426
doi:10.3390/app6120426

- Goals of the Packaging:

→ Ensure Interconnections for Inputs-Outputs, Interaction with environment:

- Electrical signals,
- Optical signals (transparent windows, optical waveguides, fibers)
- Pressure, Gases, etc.

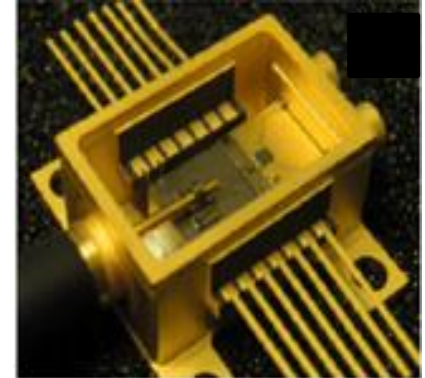
→ ~~Protect devices from environment (mechanical stability, protection from dust)~~

→ Provide correct atmosphere for proper functioning (vacuum, nitrogen, avoid moisture and contaminants)

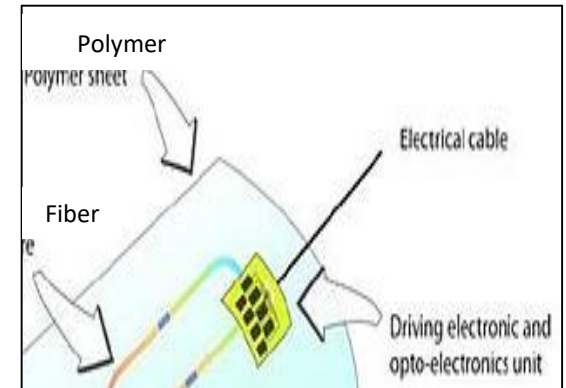
Hermetic package or Semi-hermetic package

- **Hermetic package:** a package made of metals, ceramics or glass that is airtight sealed → no gas permeation
 - Main issues due to residual moisture, organics and H₂
 - method to evaluate the hermeticity is to measure the helium leak rate; according to Mil.Standard TM 1014.11 requested Leak Rate $<1 * 10^{-6} \text{ atm cm}^3/\text{s}$ for device volume $>0.4 \text{ cm}^3$

- **Semi-Hermetic package:** package made of polymeric materials with acceptable sealing/barrier properties
 - moisture permeation may induce important problems
 - In “Semi-hermetic” packages H₂O diffusion through the materials is not negligible, in addition to the gas penetration at the interfaces;
 - Moisture permeability on polymers is several orders of magnitude greater than in metals



Carroll et al. Appl. Sci.2016, 6,426



EU funded “PHOSFOS” Project
(Photonic Skins For Optical Sensing)

Several Issues related to contaminants

- ❑ Packaged photonic devices may suffer problems related to gaseous contaminants: moisture, H₂, volatile organic compounds (VOCs), sulfur compounds

Devices	Gaseous Contaminants	Induced problems
Laser Diodes	VOCs	Performances degradation
Laser modules, Optical devices	Moisture	condensation, oxidation, corrosion on contacts, swelling
Optical transmitters/receivers, Multiplexers, etc.	Moisture, Hydrogen	Oxidation, corrosion, swelling, dark current increase; Electric changes, Signal attenuat.
Optical fibers	Hydrogen	Signal attenuation
IR detectors (with vacuum)	Residual gases	Effects on performances

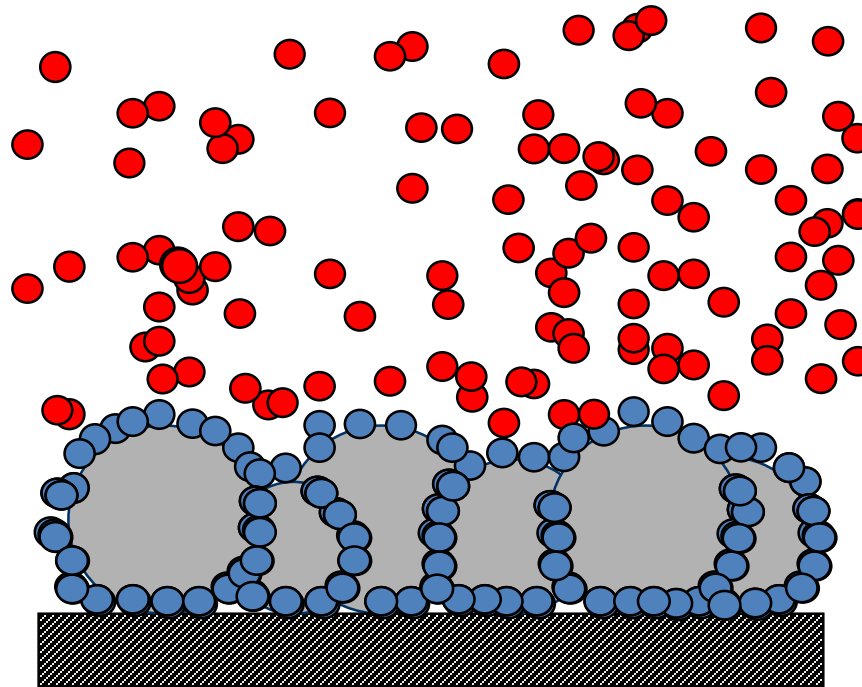
- ❑ Critical levels of main contaminants in devices: H₂O > 5000ppm; H₂ ≥ 1000ppm

What is a getter ?

A substance that removes molecules from the gas phase by
stable reactions on its active surface

Key properties of getter materials are:

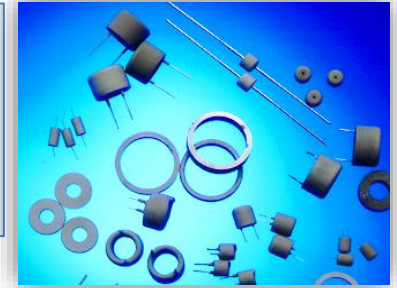
- Sorption capacity
- kinetics of the capture process



Evolution of the Getter Technology

Conventional Getters:

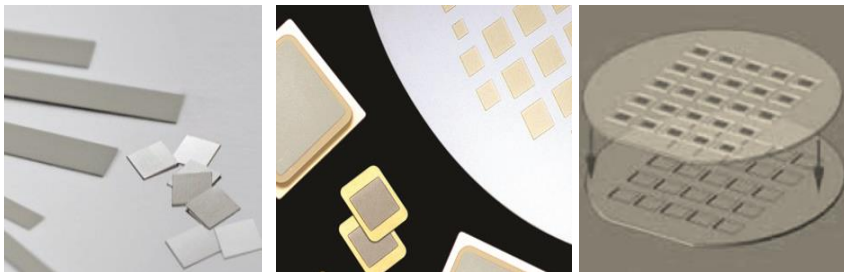
pills, pellets, strips, sintered porous structures for Lamps, Electronic tubes, X-ray tubes, IR detectors, etc.



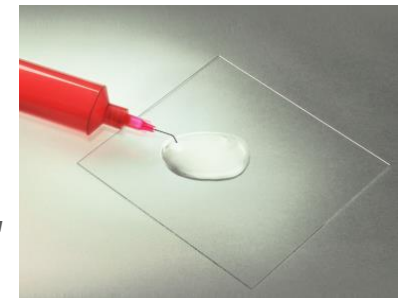
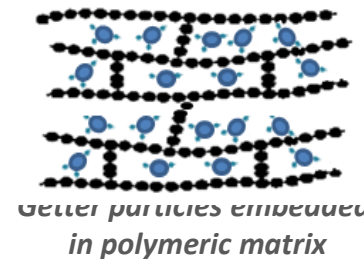
Thin Getter films and H₂ getter strips
for MEMs, RF modules, Bolometers, Sensors, and Wafer-level packed devices



Dispensable Getters and Active Sealants
for Organic Electronic devices, Smart glasses, Optoelectronic devices



Reduced dimensions, fitting in thin structures



High Flexibility, easy integration

Dispensable getter solutions

SAES developed **innovative dispensable solutions**: getter and dryer particles integrated into polymer matrices to be used in hermetically sealed or in semi-hermetic packages

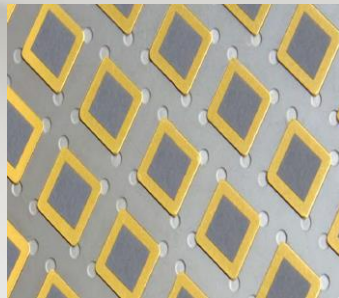
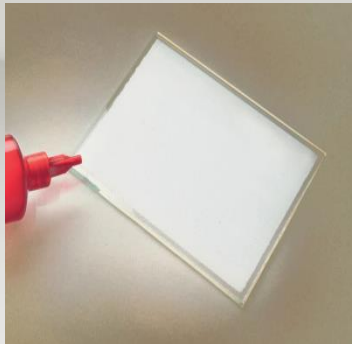
- **SAES Dispensable Getters** are paste products suitable for quick deposition process inside the devices
- **SAES Edge Sealants** based on combination of low permeability polymers and effective moisture absorbing materials: they are dispensed on the device edges and work as Active Barriers to moisture permeation for photonics devices and other modules.



Dispensable getters for Optoelectronics

Dispensable Getters

High capacity & Performance



- **Very High Sorption Capacity for H₂O: > 15% wt/wt**
- **Possible optional sorption of H₂ and organics**
- **Suitable for Processing in Air**
- **Thermal Curing**

Active barrier sealant for semi-hermetic devices

Epoxy based

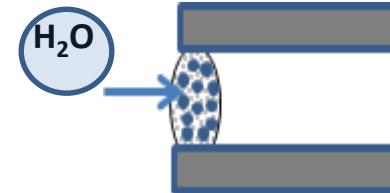
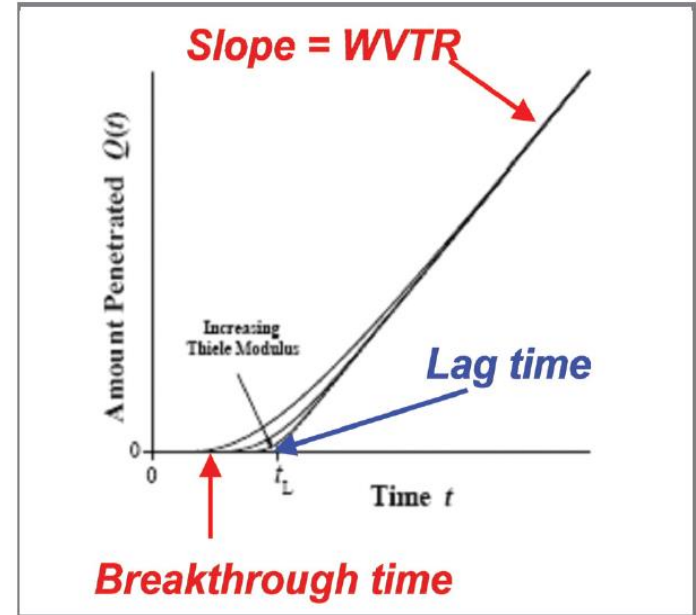
Good H₂O Sorption Capacity +
Very Low WVTR (Water Vapour
Transmission Rate)

UV Curing

Suitable for Processing in Air

**ACTIVE
SEALANT**

Very Long breakthrough Time



SAES Active Sealant greatly increases the breakthrough time (time for the first H₂O molecule to enter in the device)

Conclusions

- ❑ In several cases Optoelectronic devices can be damaged by the presence of noxious gases that alter their performances/lifetime.

- ❑ SAES developed advanced materials solutions to
 - ❖ improve the device packaging with getters & barriers
 - ❖ sorb H₂O, H₂, organics and other contaminants that can create degradation in the systems

- ❑ *SAES is willing to cooperate with manufacturers to assure*
 - *beneficial effects in hermetically sealed or semi-hermetic devices for all their lifetime*



Thank you for your attention



For any question:
marco_moraja@saes-group.com

www.saesgroup.com

This presentation was presented at EPIC Meeting on New Space 2019

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