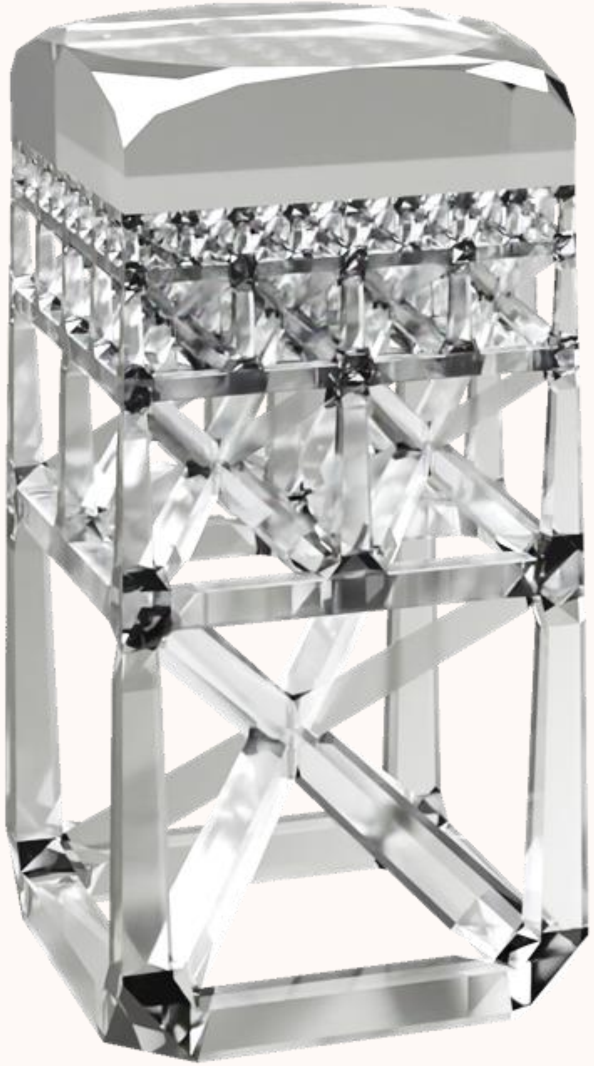
AITHRA

Next-gen 3D printing technology...

...to exceed current manufacturing limits of cutting-edge industries



Marine Bertucchi – Chief Executive Officer

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TEAM

Complementary founding team with strong experience in hardware R&D projects

Marine Bertucchi – *Chief Executive Officer*

ESPCI ParisTech · CentraleSupélec · Imperial College London

Engineering & Pre-Sales positions at GE Healthcare · THALES

Cédric Neuville – *Chief Technology Officer*

École Polytechnique Université Paris-Saclay · CentraleSupélec · cea

Author / Contributor of **10 published research papers**
Winner of **Paris Saclay's Thesis Prize**
Nominated for **Prize René Pellat**

Supports & Partnerships

CIRIMAT Toulouse

Pôle Européen de la Céramique

Les Deep Tech

bpifrance

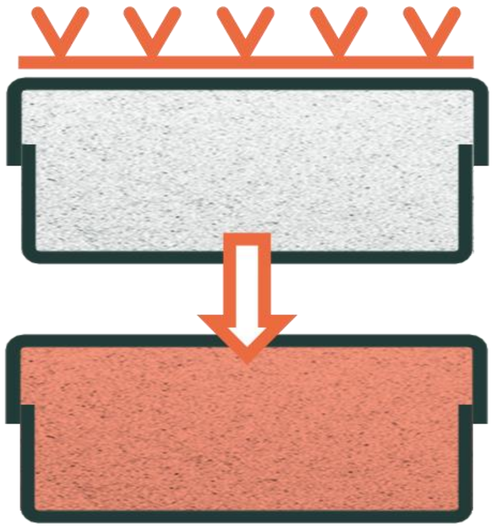
toulouse métropole

nubbo L'incubateur

PAIN

Two main ways to produce high added value pieces : High-pressure sintering on a mold (1/2)

Uniform heating
+
Uniform pressure



Limited

High-pressure sintering molds constraints are **limiting the complexity of produced pieces.** Most produced forms must be machined to be adapted to final use.

Time-consuming

Machining process is very time-consuming **to limit the breakage** and **because ceramics are very hard materials**.

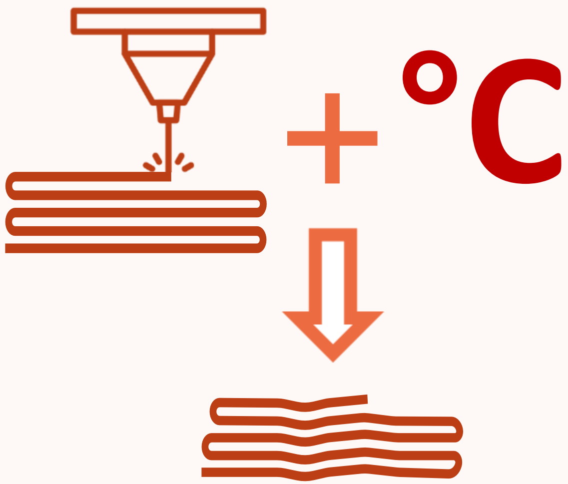
Expensive

Mold production, sintering then machining is finally a **long and expensive process** needing specialized machines **which tools are quickly consumed**.

P A I N

Two main ways to produce high added value pieces : Pressureless sintering after 3D Printing (2/2)

3D printing with binder
+
High-temperature treatment



Material Degradation

Pressureless sintering is made possible thanks to a passage through a very high-temperature oven, but it has a **degradation effect on the material capabilities**.

Distortion

The 3D Printing parameters are **not perfectly known** before a piece is produced. It generates **distortion** of produced parts, **making them not suitable for high-precision pieces**.

Time-consuming

Printing then high-temperature treatment is a long process taking from days to weeks. For each new shape, distortion uncertainty results in an iterative process that extends again production time

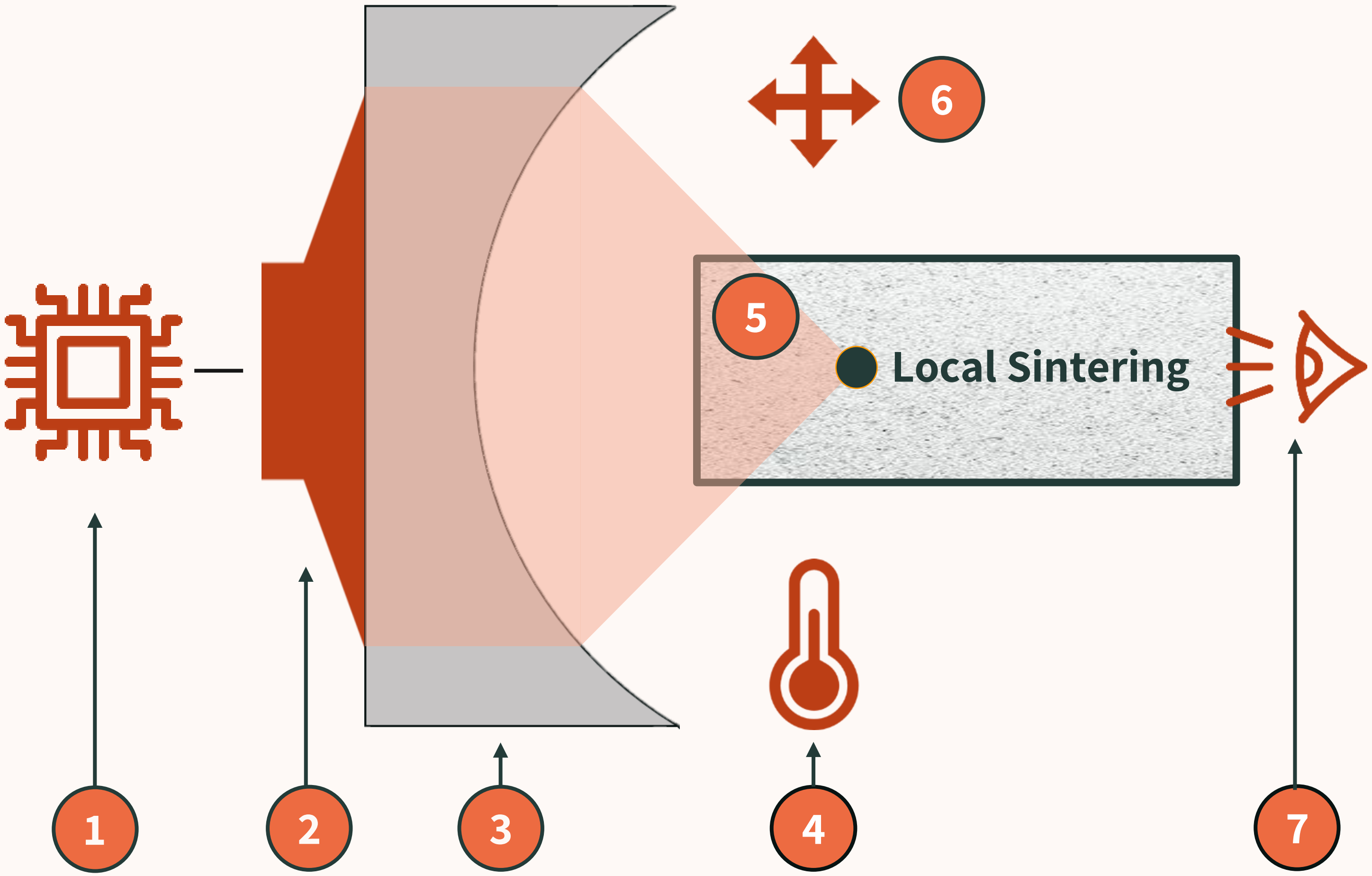
PRODUCT

AITHRA

High pressure sintering by acoustic waves to exceed the manufacturing limits of cutting-edge industries

P R O D U C T

Patented technology to merge the best of 3D Printing & mold manufacturing methods



Key Steps

1 : Power electronics + software to control acoustic waves

2 : **Acoustic wave transmitter**

3 : Lens which allows the focus

4 : Local temperature adjustment

5 : Crucible containing ceramics powder*

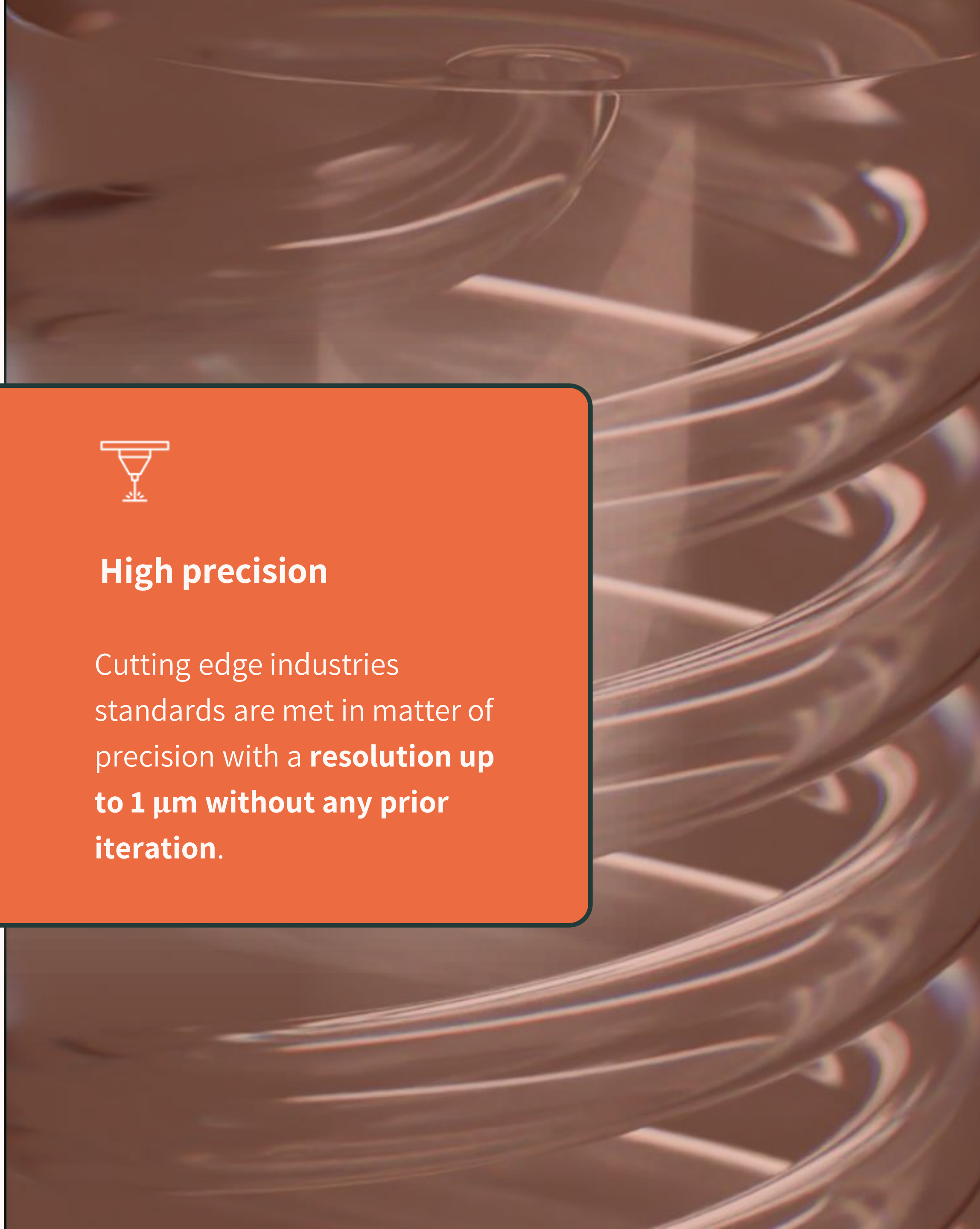
6 : **Movement of sintering point**

7 : Control of sintering process

*Ceramics : Non-organic and non-metallic material, made of many nanometric to micrometric grains : Oxides (**Zirconia**, Alumina, …) Carbide (**Silicon Carbide**, Tungsten Carbide, …), Nitride (**Aluminum Nitride**, ….), etc.

PRODUCT

Unlocking materials & forms possibilities, with the highest precision level



More materials

Aithra’s technology is made to work with optimum materials which are either **very hard to use** or **incompatible with 3D Printing.**

Complex forms

Aithra’s sintering works on **the most complex forms without using any mold**, thus removing current high-pressure sintering drawbacks.

High precision

Cutting edge industries standards are met in matter of precision with a **resolution up to 1 µm without any prior iteration**.

VISION

AITHRA

Technical ceramics are the next gold rush.
We are the solution to unleash it.

ROADMAP

4-year long R&D to be ended in 2024 with a first sales…

2021	2022	2023	S1 2024	S2 2024
First prototype design : - Power electronics - Acoustic waves' setup **Feasibility Validation**	**TRL 1 to TRL 4 on the electronics** **1st Patent**	**TRL 1 to TRL 4 on the acoustic waves' part** **2nd Patent** **Hiring of the R&D Team :** - 3 people hired - 2 people waiting the end of the fundraising **Partnership with a sintering specialist** CIRIMAT Toulouse	**First industrial prototype designed** **First sintering protocol definition** **First partnership contract with a corporate** (ongoing discussions)	First industrial prototype assembled & validated First parametric study on Zirconia **First sales in 2024** **+** **Delivery to our first customer in 2025**

Design of industrial applications for jewelry

Design of industrial applications for power electronics

End of use case definition + Roadmap with corporates

TRL : Technology Readiness Level

ROADMAP

…& from there we can replicate the process on other materials

More eligible materials for sintering over time

Machine	Sintering Pressure	Materials	Machine POC	Machine Production
P1	.25 GPa	Zirconia	2023	2025
P2	1 GPa	SiC, AlN	2024	2026
P3	5 GPa	c-BN, Diamond	2025	2027

The difference between sinterable materials in 2024, 2025 & 2026 is a matter of pressuring power.

MARKET STUDY

We are at the dawn of a multi billion-dollar market

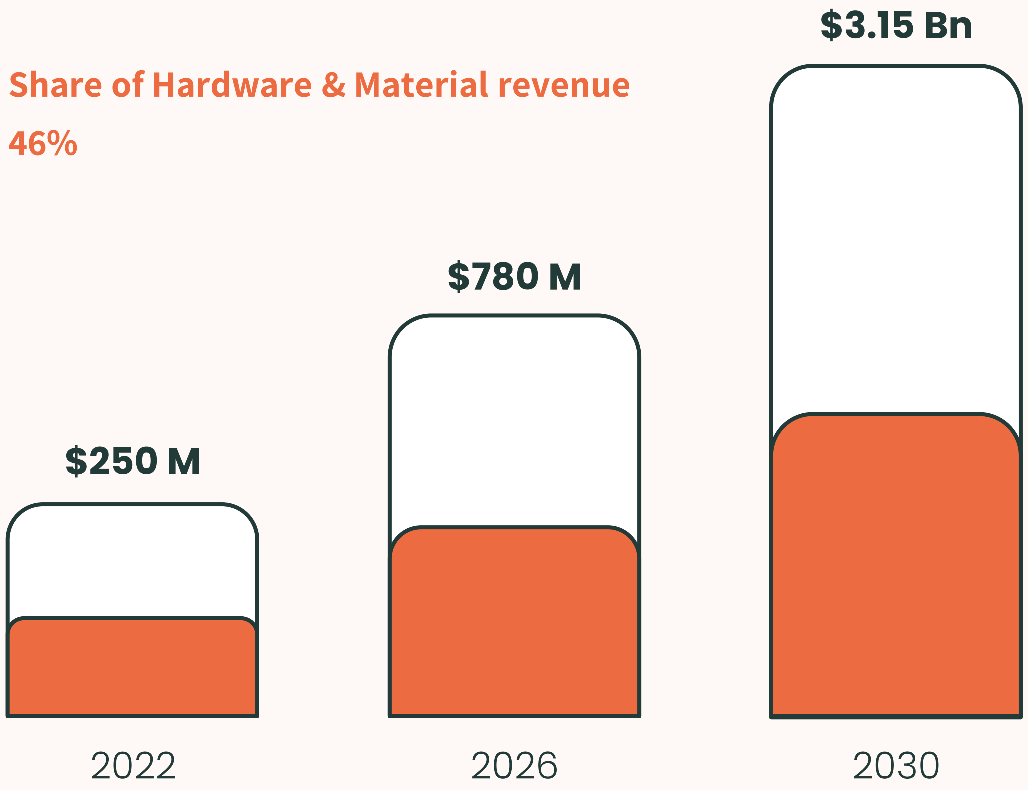
Technical ceramic manufacturing sector is expected to reach $350 Bn in yearly revenue by 2030

Est. value of Additive Manufacturing of Technical Ceramics

CAGR : 37%

Share of Hardware & Material revenue

46%



GO-TO-MARKET

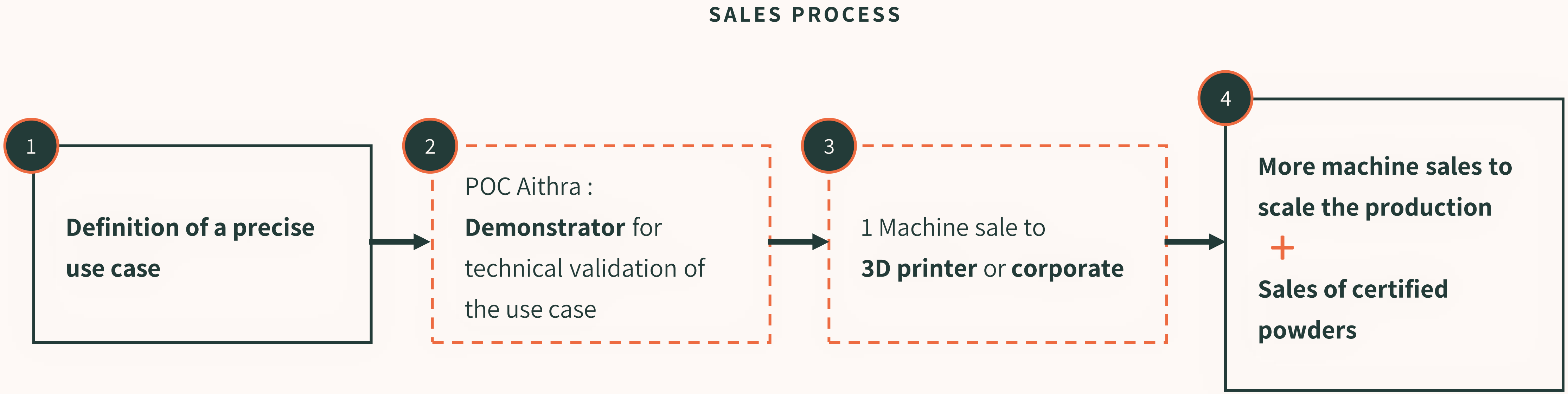
Roadmap already filled for the next 3-years, more industries to sustain our growth on the long run

Short term sales target : Industries with ongoing discussions ... **Long term sales target**

	Aerospace	High jewelry	Defense	...	Nuclear	Health
Use Case	Heat exchanger	Watches & Metal replacement in Jewelry	RF antenna		TBD	Filing
Competitive advantage	**Process**	**Workable material**	**Workable material + Process**		**Environment-friendly**	**Environment-friendly + Production time**
Identified materials	**Zirconia | SiC | AlN Diamond**	**Zirconia | Spinel AlON | Diamond**	**Zirconia | SiC | AlN Diamond**	...	**Zirconia | SiC Diamond**	**Zirconia Diamond**
Technical validation year	**2024 | 2025 | 2026**	**2024 | 2025 | 2026**	**2024 | 2025 | 2026**		**2024 | 2025**	**2024 | 2026**
Commercialization year	2025	2026	2026		2027	2027
Business stage	Definition of uses cases with future customer	Definition of uses cases with future customer	Definition of uses cases with future customer		-	-
In talk with	SAFRAN + esa	COURBET + **[under NDA]**	AGENCE INNOVATION DÉFENSE		-	-

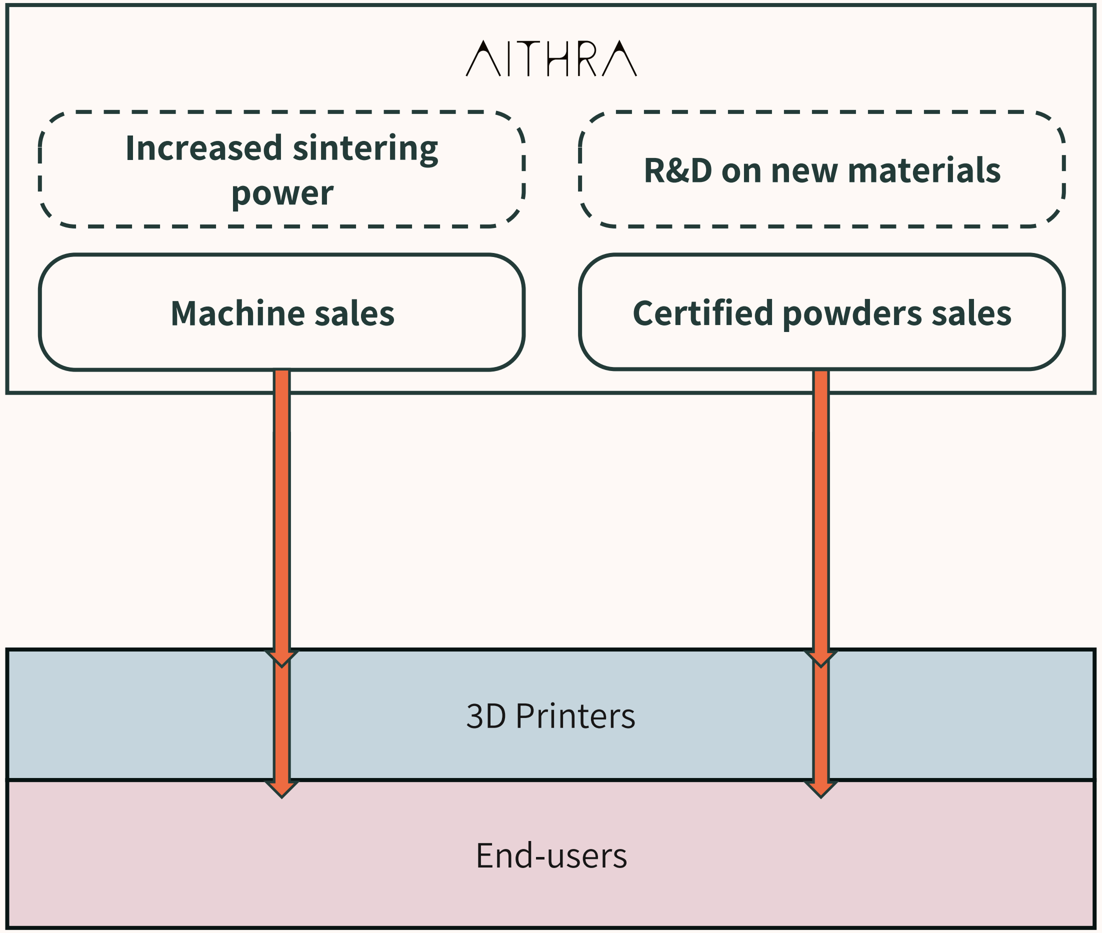
GO-TO-MARKET

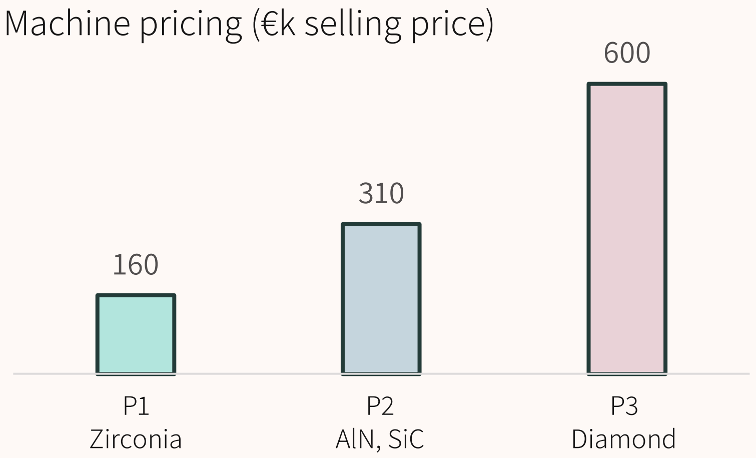
What we build is what our customers ask for

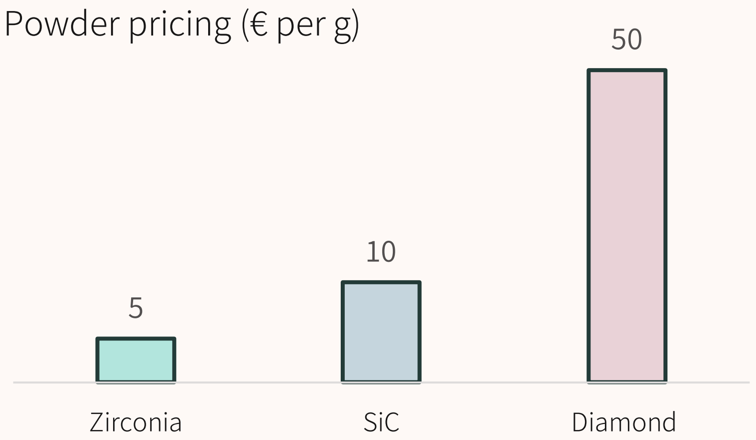


BUSINESS MODEL

Our model is meant to upsell organically as we increase the number of mastered materials







FUNDRAISING

Raising €1.6M - including €1.1M secured - to reach commercialization stage & continue R&D for next materials

Pre-Seed Q1 2021	Seed Q2 2024	Series A Q4 2025
€200k equity **+ €180k grant & debt**	**€800k equity** (300k€ secured) **+ €800k grant & debt** (secured) Searching for 500k€	**€5M** **+ €700k grant & debt** (secured)
Business Angels + bpifrance	Non-dilutive grant & debt validated (€800k for Seed & €700k for Series A) from bpifrance	
TRL 1 – 4 **First prototype**	**TRL 4 – 7** **R&D : Zirconia + SiC** **Sales : Zirconia**	**TRL 7 – 9** **Duplication on other materials**

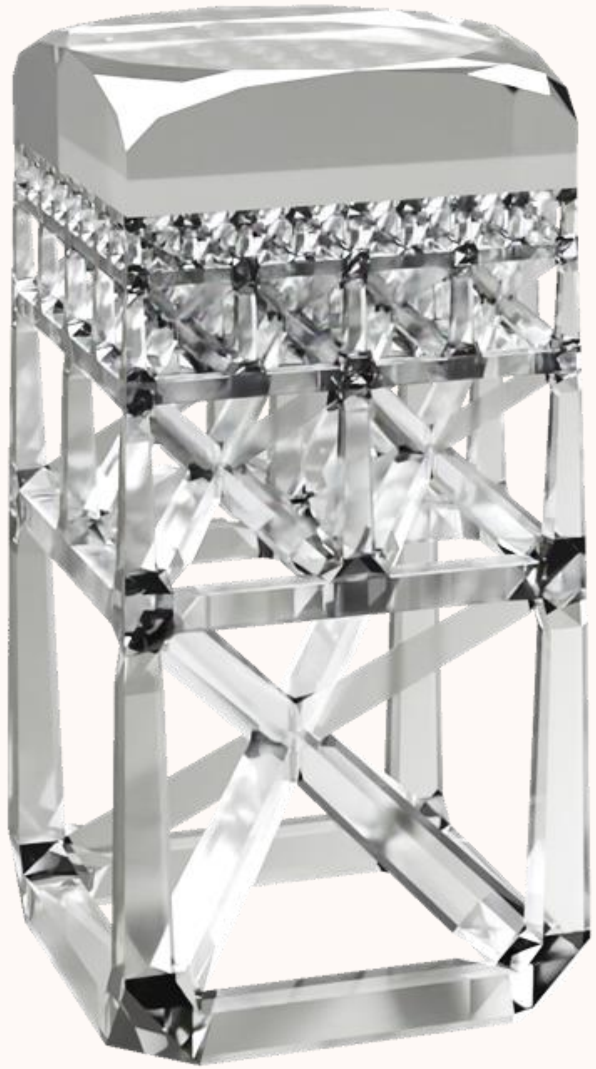
VISION

Become the #1 manufacturing solution for cutting-edge industries

AITHRA

ANGELSQUARE

Selective high-pressure sintering to go beyond cutting-edge industries' limits



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FOCUS DIAMOND

Diamond as an exponential lever of growth from 2026

Exceptional...

- Ability to **convert radioactivity into electricity** & **to recover remaining energy from nuclear waste** ;
- **Best-known thermal conductivity** (5 times greater than copper) : **Outperforms all heat exchangers and heat sinks** in the energy and power electronics markets ;
- **Enabler of a new generation of water purification** for water leaving factories and hospitals.

...but inexploited features

- No current technology **can control the shape of diamond parts** which are either small stones, small slabs or powders, **so it limits their possible uses** ;
- **These shapes are extremely difficult to manufacture** because diamond is the **hardest material known** ;
- **Financial and environmental costs of diamonds** are currently prohibitive.

A solution with AITHRA

- All shapes, whether long, wide, convex or concave, become possible, **enabling innovative uses** ;

-**Improved mechanical strength**, all other characteristics being equal ;

- **Environmental and financial costs are reduced** because
    - Generation process less energy-intensive & less complex than competing technologies ;
    - No longer any need to produce a large rough diamond to cut a small diamond.

COMPARISON

The best of 3D Printing & High-pressure sintering

	3D printing + Pressureless sintering	**High-pressure sintering**	AITHRA
Production steps	2 steps : Printing + Unbinding/Sintering	3 steps : Mold production + Piece production + Post-processing	**1 step**
Complex forms limitation	Any complex form if not too thick (<4mm)	Limited	**Any**
Use of a binder*	Yes : Polluting + Thickness limitation (<4mm)	No	**No**
Control of Shrinkage-related deformation	No	Yes	**Yes**
Material limitation	Yes	No	**No**
Post-production performances	#3	#2	**#1**

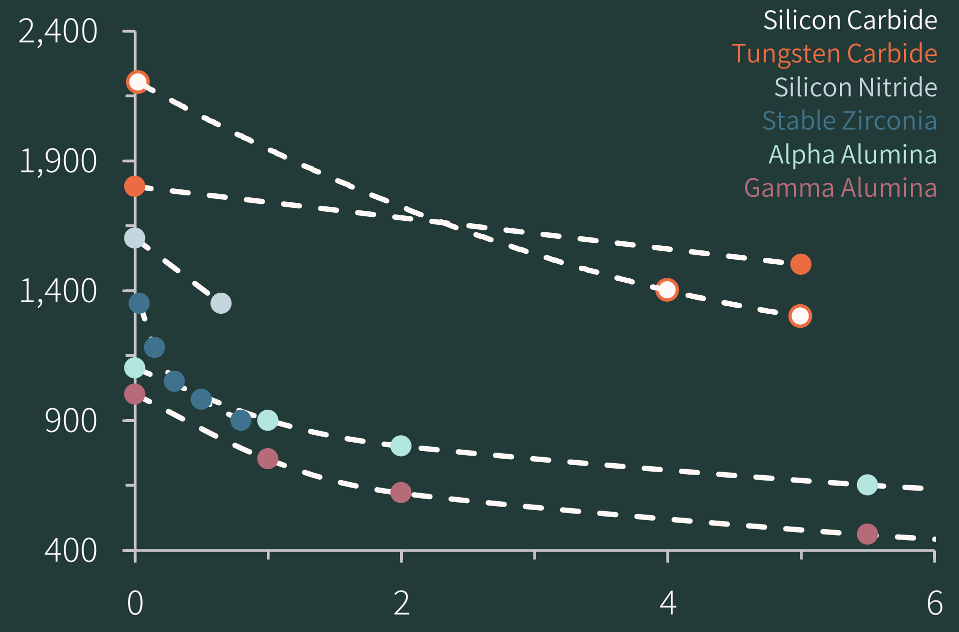
IMPACT

Best-in-class solution for both customers & our planet

High-pressure sintering is environment friendly by nature…

1. **Additive manufacturing is already less consuming in matter of raw materials and energy**
2. **The absence of binder burning (made of plastic) avoids additional pollution**

…& energy efficient as much as we increase pressuring power



ROADMAP

Estimation of performances of our first machine, outperforming existing technologies

3D Printing Key Performance Indicators	Current Technologies Best Performances	2024 [Demonstrator]	2025 [First delivery]	2026+ [Maximum performances]
Resolution	10 - 50 µm*	50 µm	25 µm	1 µm
Tolerance	35 - 300 µm*	200 µm	100 µm	10 µm
State of surface	10 - 50 µm*	50 µm	10 µm	< 1 µm
Grain size	1 - 10 µm*	200 nm	200 nm	100 nm
Density	97 %	95 %	99 %	100 %
Pressure	Ambient	.25 GPa	1 GPa	5 GPa

* Minimum values are for small pieces with simple forms, after many iterations.
Maximum values are actual performances on complex parts.

TAM

Each material is a billion-dollar business opportunity

	Zirconia	Silicon Carbide	Aluminum Nitride
Use Case	Watch and jewelry components	heat shield for atmospheric re-entry (missile & spatial)	Heat sinks
Use Case	Thermal barrier	Heat exchanger	Opto-electronics thermal management
Use Case	Fuel cells	Furnace components	Electric insulators
Use Case	Dental implants	Spatial optics	Electronic Substrates
Use Case	Antennas	Cutting & abrasive tools	Military Applications
Market (in $ Bn)	5.3	3.3	1.3
CAGR	6.8 %	11.7 %	8.8 %

ROADMAP TEAM

Current & future FTEs

CURRENT EMPLOYEES

Antoine D.
Position : Acoustics Engineer
Exp. : Experimental Physics

Cloé B. [PhD CIFRE]
Position : Research Engineer
Exp. : Additive manufacturing & SPS

Marc M.
Position : Architect Engineer
Exp. : Multi-physics simulations

HIRED POST-FUNDRAISING [CONFIRMED]

Pauline D.
Position : Algorithm Engineer
Exp. : Algorithms & AI

Frédéric P.
Electronics Expert
Exp. [25 yrs] : Power electronics for acoustics