

## MATERIALS

Vulkalloys®, a breakthrough innovation in metallurgy.

The Vulkalloys® range is made up of amorphous metal alloys designed by the Grenoble-based company Vulkam for the miniaturisation of micromechanical systems. From their design to their shaping, Vulkam's technology is a breakthrough innovation. Focus on one of these amorphous metal alloys and the viewpoint of the company's president, Sébastien Gravier.

The technologies proposed by Vulkam respond in a differentiated way to the new challenges of the micromechanical industries at two levels. The first level is associated with the specificity of amorphous metal alloys which have exceptional mechanical, physical and chemical characteristics. The second level is related to the unique processing methods that allow the production of unique and high precision miniature components. Vulkam responds to a demand from industrialists to design and produce parts made of Vulkalloys® whose mechanical and physical properties are much better than the characteristics of conventional metals used in micromechanics. The range of Vulkalloys® proposed by Vulkam includes about ten references, which is one of the most important on the market of amorphous metals intended for the realization of components for micromechanics.

Vulkalloy® Zr, a family of innovative alloys

Vulkalloy® Zr is particularly suitable for miniaturization. It has unmatched mechanical properties. It can reach an elastic stress of up to 1890 Mpa and an elastic deformation of up to 2% compared to 316 L Stainless Steel (240 Mpa and 0.1%) and Titanium TA6V (860 Mpa and 0.7%), a high hardness of up to 50 HRC compared to 316 L Stainless Steel (14 HRC) and Titanium TA6V (41 HRC). In addition, these outstanding properties of Vulkalloy® Zr allow specific strengths of up to 295 kn.m.kg-1. These characteristics result in a much higher strength, very good flexibility and the possibility of significantly reducing the weight and dimensions of mechanical systems. These characteristics make it possible to increase the mechanical strength, fatigue resistance for example, or durability, all associated with reduced maintenance. One translation of these capabilities is the design of miniaturised components (from a few mm<sup>3</sup> to 1000 mm<sup>3</sup>) and compact systems well adapted to new industrial demands. This is made possible by adapting the properties around the various alloy compositions associated with Vulkalloy® Zr. Their properties allow access to previously unimaginable innovative designs.

The process is also a breakthrough technology...

...Guaranteeing the amorphous structure and the associated properties. The use of Vulkalloy® Zr by innovative and unique patented thermo-moulding processes allows the production of final parts or associated with complementary technologies for final shaping. These processes represent a technological and economic breakthrough for the production of miniature components. They ensure that the amorphous state of the material associated with the above-mentioned superior characteristics and properties is achieved. The design of miniature components in Vulkalloy® metal alloy combined with the thermo-moulding process offers a unique differentiation in several ways.

Yves Mathieu, Business Developer at Vulkam explains: "Once the alloy has been produced, its injection by thermo-moulding makes it possible to shape the components in a single step to the required dimensions, tolerances, surface finish and roughness. Current processes for making miniature components often include costly technologies with a high number of steps and re-machining. "The manufacturing range can thus be simplified, fast and economical depending on the types of components and series. Another major challenge is access to Vulkalloys® thermo-moulding technology, which enables the manufacture of components that are difficult to produce by conventional means, in particular because of the ability to shape by injection a very wide range of geometries and surface finishes, obtaining dimensional accuracies of up to 1µm and roughnesses of up to Ra=0.2µm, depending on the type of mould (metal, silicon, etc.).

### The perfect Vulkam part

Vulkam's know-how allows it to adapt the chemical formulation of Vulkalloys® according to the needs and to offer a wide range of functional properties. The Vulkalloy® Zr range, for example, is ideal for miniaturization and is of interest not only to the aerospace industry but also to the medical sector, notably for its biocompatibility and ease of processing to produce the complex shapes of surgical instruments for example. For the production of components in medium and large series, the industrial process is the perfect answer because, once the tooling is designed and produced with its high repeatability and reproducibility, the quality of the parts is guaranteed to be flawless with an excellent surface finish when the parts are moulded. Yves Mathieu adds: "Vulkam's process, from material elaboration to mass production of parts, also perfectly fits any innovative and ambitious industrial strategy of Vulkam's partner companies, with a 'proximity sourcing' policy chosen to keep control of the development of high added value solutions while preserving intellectual property, know-how and competitive differentiation on the international market of microcomponents, miniature components or millimetric components. Vulkam offers a unique combination of innovative materials and processes; the company will have around ten patents on its multiple know-how by the end of this year.

Innovation, a strategic approach for Vulkam, described by Sébastien Gravier, founder and president of Vulkam.

Galvano Organo: What does Vulkam's breakthrough technology consist of?

Sébastien Gravier: Vulkam addresses several industrial markets: aerospace, luxury watchmaking, defence and medical. To meet the demand, Vulkam controls the entire production chain: from the formulation of alloys to their development and shaping to the manufacture of the final part, including the tools for characterising the health of the material. We have invested nearly €1.5M in production equipment, which is in line with our ambitions for a company that was created only 4 years ago. Each request is a project developed with our customers according to their specifications.

GO: How is Vulkam positioned on its market?

Sébastien Gravier: In Europe, manufacturers of amorphous metal alloys are positioned on the manufacture of large parts. Vulkam, thanks to the know-how of its team, about twenty in total - doctors and engineers for the most part - is the only French and European company, and even the only one in the world, to operate in the field of metallic glasses for small optimised parts. Today, our customers are large companies. To illustrate, we have designed for LynRed, a major player in the defence and aerospace industries, ultra thermal insulating materials for its infrared detectors. The aim is to reduce the amount of insulating material needed. The demand for innovative materials will grow to meet the challenges of tomorrow.

GO: What are Vulkam's projects to meet these challenges?

Sébastien Gravier: One of the main challenges is the reduction of energy consumption, which requires, among other things, less consumption of materials. New materials will emerge and Vulkam is preparing for this. A production line is planned for 2022, with a gradual increase in rate to 'tangent' by 2023 towards the million parts to be produced in Grenoble, close to the research centres from which I myself and part of the team are drawn. Our roadmap is clear, we know where we're going and we have the skills to optimise costs. One of our objectives is to propose our offer to small and medium-sized companies in the micromechanical industry. Vulkam is deploying sustainably for the industry of tomorrow.

For more information: [www.vulkam.com](http://www.vulkam.com)