# Shape memory materials ready for mass production

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Five years ago, Professor Mirko Gojic, a researcher at the University of Zagreb in Croatia, wondered what his small team of researchers could do to lower the price of 'smart metals': a type of high-tech materials that can remember their original cold-forged shape, returning the pre-deformed shape by heating – a property that makes them crucial in a series of industries. The idea was there, but problems quickly aroused from lack of money and key equipment. Thanks to the support of EUREKA, the product is now almost finalised and could be rolled out within the next two years. Gojic thinks that this international research project he led could soon turn into commercial production of a cheaper alloy for use in aerospace engineering or electronics.

Shape memory alloys can be produced to many shapes and sizes for various uses. Although not as strong as steel, they are much more elastic and their properties allow them to adopt the needed shape when exposed to high temperatures. They are used in smart phones, robotics and for medical purposes. For example, nickel-titanium alloy balloons that expand and adapt to the shape of a blood vessel when exposed to body temperatures are used in stent grafts and surgery.

One of the key problems with manufacturing such materials is their high price. Gojic and his team embarked on producing a new, cheaper alloy, based on copper, whereas the most-used alloy is built on a half-half mix of titanium and nickel, known under its trade name Nitinol. 'It is also the most expensive alloy, so there is a lot of effort going into finding an economically viable alternative', says Gojic. The research project called

RSSMA, for Rapidly Solidified Shape Memory Alloys, lasted three years.

"We are not the only ones to put our efforts into research on copper alloys, we contributed to the extent of the possibilities offered by our infrastructure and benefited greatly from collaborations with international partners". Trans-border cooperation between R&D partners is one of the pre-requisites to receive financial support from EUREKA.

The Croatian team did not have the facilities to produce the new alloy, but the EUREKA grant allowed them to grow an existing collaboration with colleagues from the Faculty of Mechanical Engineering at the University of Maribor, Slovenia who helped to produce the alloys, which were then tested and examined for their characteristics in Croatia. They also collaborated with colleagues from Montanuniversität Leoben in Austria, and the Faculty of Natural Science and Engineering, University of Ljubljana in Slovenia.

'It is difficult to know exactly how much cheaper the final product will be – it is an important economic parameter to evaluate the success of the project – and it depends partly on techniques used to produce the alloy, but it would certainly be a cost-effective alternative, as titanium and nickel are far more expensive raw materials than copper and aluminium.' Besides the economic requirements, materials used in the production of alloys also have to comply with a certain level of purity and hold specific properties in order to be worthwhile for the industry. 'Tests so far have shown that we are on the right way and we should be able to enter soon in the production phase', Gojic says.

"We have successfully reached the final stages of the research and testing, notably in setting up a process of 'continuous casting', which is crucial for commercial production," he says. "It is important because it allows you to get an important quantity of semi-product, you can make it

without interruptions, allowing for mass production, as it is done with other common metallic materials, such as steel."

The next step will be to pursue research, aiming to have a finalised product within the next one and a half years, followed by the construction of a pilot plant and then finally the take-off of the commercial production. If the next stage of the research goes well it should lead rapidly to the creation of a spin-off pilot firm to manufacture the new alloy. 'This would require more funding and I am considering applying for a further grant that would help us get to the pilot stage, which could then eventually lead to industrial scale manufacturing of the new, cheaper alloy.'

The new alloy has great commercial potential, it would mainly be used in electronics and mechanical industries, since it does not hold the biocompatibility properties of nickel and titanium. It might also find use in the booming market of smartphones and high-tech gadgets. "It would not have been possible for us to improve our knowledge and competencies without EUREKA," Gojic admits.

The grant also allowed the team to put money towards buying new equipment, such as a scanning electronic microscope and equipment for thermal analysis which was important in studying the properties of the alloys developed during the research project. Financing for the new equipment several sources, but the team had to make their own initial investment in order to be granted access to it, and EUREKA allowed them to do so. The team now continues to use this new equipment to develop the project further but also for new research activities in the field of smart materials.

Provided by EUREKA

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