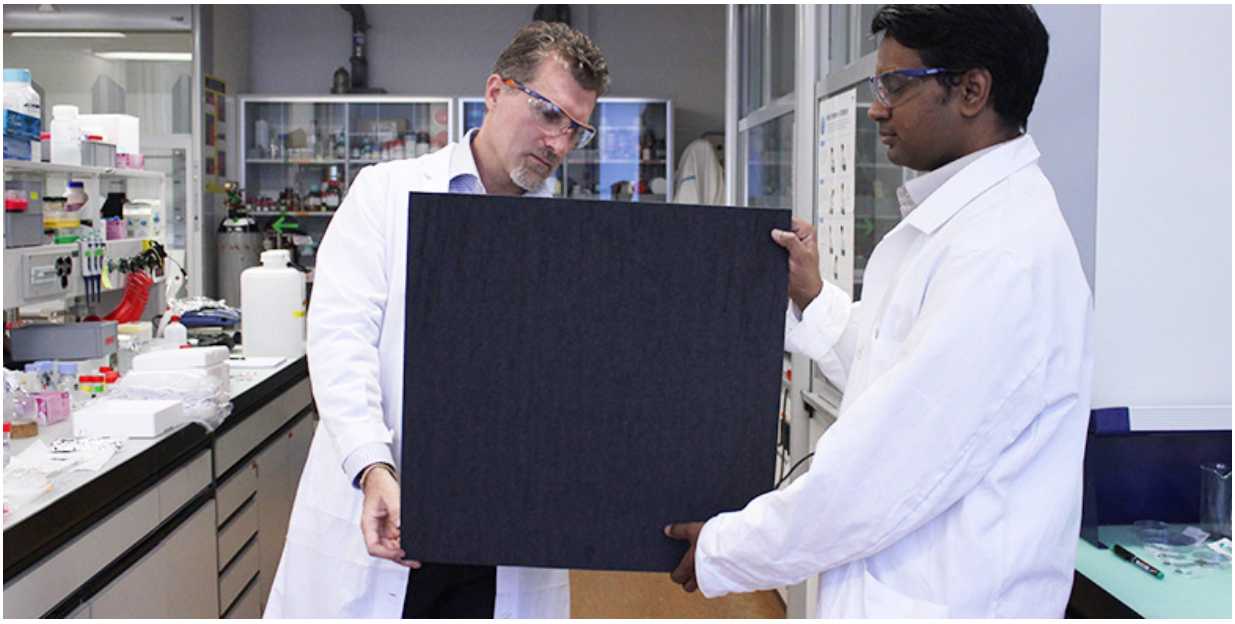
Hybrid membrane creates a stir on the global market

June 13 2017



Sreenath Bolisetty and ETH Professor Raffaele Mezzenga (l.) check a sample from their hybrid membrane. Credit: Image: Mezzenga Lab / ETH Zurich

The news story made a big splash: in January 2016 ETH researchers Professor Raffaele Mezzenga and his senior researcher Sreenath Bolisetty published a study in the journal *Nature Nanotechnology* about an innovative type of membrane developed in their laboratory.

They showed that this membrane could effectively filter out heavy

metals, radioactive waste, other toxic substances, and bacteria from polluted water. The filter can also trap ions of gold, platinum and palladium, allowing the recovery of precious metals. What's more, the composition of the membrane is extremely simple: a mixture of denatured whey proteins and activated charcoal applied to a filter paper as a substrate.

Inundated with enquiries

The story was taken up by the global media and soon the researchers were inundated with queries: from a housewife in Hong Kong worried about her family's health to mining companies searching for a solution to treat polluted wastewater from mines, the researchers still find themselves slightly overwhelmed by the number and variety of the enquiries they receive.

In May 2016, Mezzenga and Bolisetty therefore founded the ETH spin-off BluAct Technologies GmbH, with the financial backing of the investor Keith Boonstra. Bolisetty is both CEO and Chief Technical Officer for the new company. Mezzenga has more of a background role as shareholder and scientific advisor.

BluAct itself has just produced its first batch of prototype membranes at the industrial scale. The spin-off has used the start-up capital to nationalize patents for the membrane in 90 different countries. "That was very complicated and expensive, as it's not possible at the nationalization step to simply have one legal protection covering all these countries," Mezzenga explains. But because the technology is relatively simple, they had to protect it from copycat products.

Licensees produce the membrane

For the time being, the production of the membrane is outsourced to external partners. Here BluAct ensures that the quality of the product meets the relevant specifications. As Chief Technical Officer, Bolisetty will monitor and screen the producers on site. "It looks like I'll be travelling a lot in future," he grins.

BluAct is able to supply all the necessary equipment to bring this technology to the real world. The plan is to fit the membrane into already existing filter press systems to replace the current filters. The ETH entrepreneurs have already notched up their first success, by signing a contract with the ISL Group, for the distribution of bottles for drinking water that exploit the technology developed by BluAct.

Through NGOs and state authorities, these bottles will be distributed in Asia, Africa and Latin America to people without access to clean drinking water. "This is purely a humanitarian project that is very close to our hearts.," stresses Professor Mezzenga. To make sure the hybrid filter also reaches the poorest people, BluAct is working with the local authorities at any levels. In the Indian state of Andhra Pradesh, for example, land has already been made available to build a production facility.

The two young entrepreneurs aim to earn money from the much bigger interested parties, such as mining or industrial companies, as there are virtually no limits on the potential uses of this membrane for water treatment.

The prototype membrane is only 3 mm thick, but in principle can be made to any size, from the size of a large coin for household filters up to a square meter for industrial applications. In addition, several membranes can be placed on top of each other or arranged in series for processing large volumes of water. In this way, it should be possible to build a filtration plant capable of treating 100,000 litres of water per

hour.

Many potential uses

The BluAct founders are currently in contact with mining companies that have noted an interest in acquiring the revolutionary technology to capture heavy metals. The membrane is currently being tested by an operator for decontamination of European nuclear plants, as the filter can trap not only heavy metals, but also radioactive uranium. It could therefore be used to decontaminate radioactive water as well.

Other lines of business being targeted by BluAct include heavy metals and electroplating industry (for recovering valuable metals), agriculture and, last but not least, water treatment for private households. In their latest study, Bolisetty and Mezzenga have demonstrated that the membrane is also extremely efficient at removing arsenic from water. The ground-breaking filter is therefore a low-cost option for many parties in areas where this toxic substance is a threat to human health.

To develop and expand their new enterprise, Bolisetty and Mezzenga need more investors. Neither Bolisetty nor Mezzenga are prepared to make a guess about the potential for BluAct in general. "Clean drinking water is immensely important worldwide, but we can't tell at the moment just how big our company will grow," Bolisetty says. " I'm currently focusing my best efforts on BluAct, as we work very hard to bring the technology in all possible water sectors".

Arsenic removal

In a new study just published in the journal *Chemical Communications*, Bolisetty and Mezzenga show that the hybrid filter they have developed is able to trap both arsenite and arsenate efficiently and remove virtually

all traces of it from water. Furthermore, the membrane can be reused over several filtration cycles without losing efficiency.

The ETH researchers were able to prove the efficacy of their method by testing real contaminated drinking water taken from the area around Lake Atitlán in Guatemala. This region is characterised by volcanic rock, and the groundwater naturally contains high levels of arsenic and mercury. Samples of the local drinking water may contain up to 80 micrograms of arsenic per litre. This is eight times the threshold of 10 micrograms of arsenic per litre recommended by the World Health Organization (WHO).

The next steps include adapting this new technology to domestic filters in Guatemala, through a collaborative project between Prof. Mezzenga's laboratory and the Center for Atitlán Studies at Universidad del Valle de Guatemala (UVG), headed by Dr. Monica Orozco. Providing a relatively low-cost solution for these families will considerably reduce the risks associated with chronic exposure to Arsenic.

More information: Sreenath Bolisetty et al, Efficient purification of arsenic-contaminated water using amyloid–carbon hybrid membranes, *Chem. Commun.* (2017). DOI: 10.1039/C7CC00406K

Provided by ETH Zurich