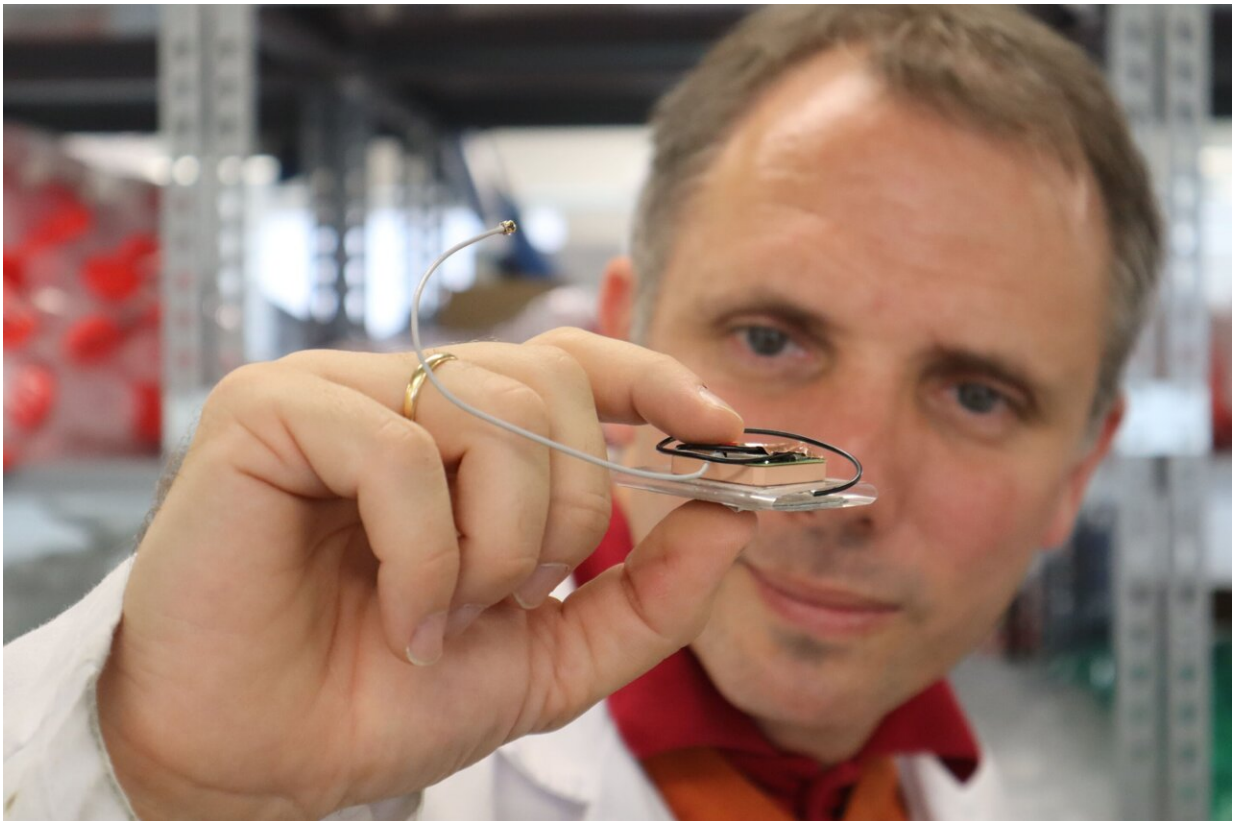


An innovative 'smart mask' with a use beyond pandemics

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IMDEA Materials Visiting Researcher Dr. José Sánchez del Río Sáez shows off a prototype of the smart mask sensor. Credit: Andrew Johnston, IMDEA Materials Institute

A group of researchers in the Madrid region have developed and

patented a new smart mask with an innovative design that can monitor a wearer's vital signs from up to 20 km away.

And its inventors hope that these [masks](#) will serve both to combat the next pandemic and for a wide variety of other applications of benefit to society.

The mask is one result of the Materials and Models Against Pandemics (MAMAP-CM) project, supported by the Community of Madrid, and is thanks to a collaboration between IMDEA Materials, the Technical University of Madrid (UPM) and Rey Juan Carlos University (URJC).

Different smart masks are capable of a variety of functions, including monitoring a person's vital parameters, breathing, pulse and blood oxygen saturation among others.

"Today, there are quite a few such masks on the market in the wake of the pandemic," said Dr. José Sánchez del Río Sáez, visiting scientist at IMDEA Materials and professor at the UPM's School of Engineering and Industrial Design (ETSIDI).

"However, most of these masks are usually quite a bit more expensive than normal masks and, in many cases, are very stiff and uncomfortable in order to be able to integrate their [sensors](#) to monitor the person's vital signs."



IMDEA Materials Visiting Researcher Dr. José Sánchez del Río Sáez shows off a prototype of the smart mask sensor. Credit: Andrew Johnston, IMDEA Materials Institute

"So, what are the advantages of our masks? In addition to the fact that they are low cost, weigh nothing and can transmit a signal over a long distance, the other advantage is that they are very resistant to adverse conditions."

Dr. Sánchez del Río is one of the principal investigators of the project together with Dr. De-Yi Wang of IMDEA Materials and Prof. Alejandro Ureña Fernández of the URJC. David Patrizi (ETSIDI) and Antonio del Bosque (URJC), in collaboration with IMDEA Materials, have worked in the electronics and fabrication of the novel materials respectively.

The result of this collaboration is a sensor that can be attached to, and removed from, an existing mask, or fabricated directly into a new mask as a single part. The other novelty of the design is that it can alternatively incorporate a triboelectric energy sensor (TENG).

These sensors stand out for their ability to generate high electrical power without the need for a separate power supply. They charge themselves by generating energy through friction between their two layers, one positively charged and the other negatively charged.

"We have a polymer material that, when deformed, changes its [electrical resistance](#)," explained Dr. Sánchez del Río. "By connecting a small battery to it, we can measure the change in voltage due to the change in resistance of the material being deformed by the movement of the mask as you breathe."

"Through this voltage change, we can monitor the person's breathing rate. In addition to this material, we can use a TENG, together, or separately, for the same purpose and with the added advantage that we do not need a battery."

As part of the project, Dr. Sanchez del Rio, a specialist in sensorization and process automation, has focused on integrating the material with its communications system.

In addition to the TENG sensor, the design of the new smart mask also includes the incorporation of a small chip that can transmit the signal wirelessly and in real-time over a distance of up to 20 km in interurban areas and 2 km in urban areas.

This gives it utility for myriad uses, including operating in hospitals as a centralized monitoring system for their patients, and in environments where workers are exposed to extreme conditions of humidity,

temperature or smoke.

"It has a utility far beyond just pandemics," Dr. Sanchez del Rio stated. "If you look at the figures, between the ages 40 and 100, 10% of deaths are related to respiratory problems. There are many older people who have breathing problems caused by preexisting conditions.

"Imagine you have a family member with this type of problem at home. Remote, [real-time](#) monitoring is going to be very useful because a health service or a doctor is going to be able to monitor these pulses and this breathing rhythm."

"Also, there's software that's going to indicate when there's a breathing problem. And that is going to give a warning to the wearer of the mask as well."

Provided by IMDEA Materials

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