CASE STUDY

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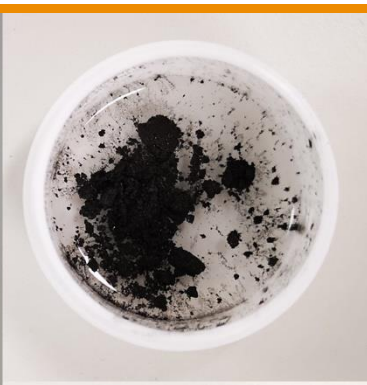
adhesives, coatings, sealants & equipment
for your manufacturing and technology applications

Preci-Tip™
Precision
Dispensing Tips

THINKY
ARM-310
Engineering
Compounds Mixer



Our customer

Department of Automatic Control and Systems Engineering (ACSE) at The University of Sheffield

Customer benefits

- Fine print quality without blockages
- Mixing in seconds to minutes
- Removing the use of solvents for better health and safety
- Improved repeatability and consistency

Improving mixing accuracy and repeatability for 3D printed bioelectronics research

To help improve monitoring of recovery from injury and the progression of neurological and musculoskeletal conditions, a team of researchers at the **Department of Automatic Control and Systems Engineering (ACSE)** at The University of Sheffield is developing a diagnostic glove.

Once available on the market, patients could wear the glove while performing a series of tests and repeating them over a period of time, so that clinicians and healthcare professionals can build a picture of their health. The glove could help understand either how a patient's health is deteriorating, such as in the case of progressive conditions like muscular dystrophy, or track how they are recovering from an injury such as nerve damage.

Fine dispensing of viscous materials

The glove is designed from conductive, stretchy material, including several flexible bioelectronic sensors. The sensors are formed by mixing elastomers with various conductive nano or micro particle compounds, like graphite, platinum and silver, and 3D printing this mixture onto the material. However, during development the team was facing some challenges in 3D printing the sensors onto the material effectively.

To dispense tiny amounts of material, the ACSE team uses an extrusion-based 3D printer. During dispensing, material was clogging in the nozzle due to the formation of particle aggregates, and by particle distribution being altered when

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travelling down the needle during the dispense. The team was looking for the finest print definition without clogging in the needle, a challenging balance to strike.

For a solution to this problem, the ACSE team contacted Intertronics, who recommended **Preci-Tip™ Precision Dispensing Tips**. Their design has a streamlined conical fluid path that delivers smoother, higher fluid flow rates and lower dispense back pressure compared with most standard dispensing tips, resulting in improved accuracy and much reduced clogging. These rigid thin-walled metal nozzles have high dimensional accuracy, with output diameters as low as 50 µm. Their industry standard Luer Lock fitting mean they were compatible with the University's existing equipment.

Thomas Paterson, Postdoctoral Research Associate at The University of Sheffield, said,

> *"Intertronics gave us clear advice on which products might be suitable for our application, and were able to explain how we could achieve return on our investment."*

The customer reported that the Preci-Tips worked well on their highly viscous silicones, they offered good flow, good fluid break off, and stopped agglomerations. The results were better definition and a more reliable system, without blockages during the 3D printing process.

However, further discussion revealed that they had challenges with the blending of the filled polydimethylsiloxane (PDMS) mixtures and were finding the process frustrating.

Making mixing repeatable

The process involved mixing nanoparticles into the very viscous PDMS to produce a graphite composite. The ACSE team were adding the solvent hexane to reduce the viscosity of the mixture and therefore aid mixing. The hexane had to be removed post printing, by raising the ambient temperature to allow the solvent to evaporate. As the end device is intended for medical research with potential human application, extra requirements would be placed on the team to prove that all the solvent was removed from the material. In addition, there were health and safety considerations for team members using the hexane.

The team were finding that manual mixing introduced air into the material. To improve the mixing process, the ACSE team initially tried using a sonicator probe, but the high viscosity made it time consuming.

Paul Whitehead, Internal Sales Executive at Intertronics said,

> *"When we start working with new customers, we always try to find out the why behind the what. During the conversations I had with Tom, I developed an understanding of the application and its challenges, meaning over time I could make some recommendations on how the team could solve other problems."*

Intertronics then suggested the team consider trialling a THINKY Mixer to achieve better mixing success. These industrial non-contact planetary centrifugal mixing machines use both rotation and revolution of material in a container under an acceleration of 400 G to achieve consistent mixing results. Because mixing takes place in removable containers, there is no mess to clean up and minimal risk of contamination — the mixer can easily be repurposed for use in different applications throughout the University.

In a THINKY Mixer, even materials of very high viscosity, such as those used by Sheffield University, can be mixed in a matter of minutes. The non-contact mixing process means instead of adding air, there is a tendency to remove it.

After trialling a THINKY Mixer, the team invested in a **THINKY ARM-310**. So far, the most prominent benefits have been removing the need for solvents as a mixing aid, removing a step from the process, improving health

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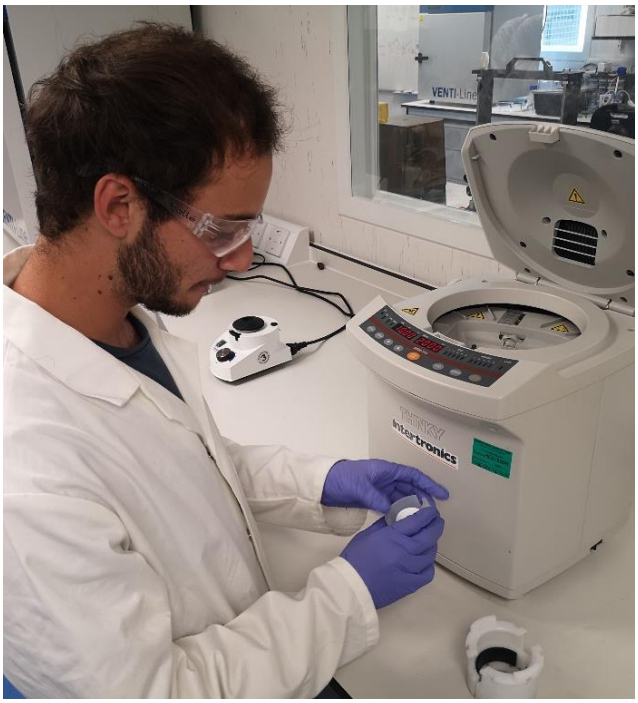
and safety, and increased repeatability. The THINKY Mixer enables the team to document the exact time and speed of the mixing, which makes the process parameters trackable.

Thomas Paterson said,

> *"Thank you to Intertronics for suggesting the THINKY Mixer, it is a huge improvement on our previous process and means we can achieve consistent outcomes more quickly. The mix quality is extremely good, the mixer doesn't introduce air into the mix, and we're making a substantial time saving.*
>
> *"Intertronics was very responsive, easy to work with, and offered great advice, I appreciated the team taking an extra interest in what we are doing. If we ever have any questions again, we'll approach them!"*



Flexible wearable electronics have a great deal of potential for future applications and the ACSE team is currently working with clinicians to evaluate the potential of the technology for disease monitoring applications.

Preci-Tips

- High accuracy, repeatable dispensing
- Dispense dots and beads as small as 50 microns
- Tips are clog-resistant and tapered for ease of flow, with good fluid break-off
- Resist stringing
- Industry standard Luer Lock fitting compatible with any of our dispensing valves, pumps, or barrels

Applications include: Dispensing of adhesives, UV cured adhesives, filled adhesives (thermally or electrically conductive), solder paste. Automated dispensing applications with tight tolerances and micro quantities. Applications and processes requiring repeatability and accuracy for validation, such as medical device assembly. Placement of viscous, small diameter dots and lines.

THINKY ARM-310 Engineering Compounds Mixer

- Mixing in seconds to minutes
- Processes in your containers such as jar, barrel, cartridge, syringe or tube
- Processes from 0.5 ml - prevent valuable material wastage
- No damage to material unlike the use of rollers, mixing blades or propellers
- For materials with various densities and viscosities, or dry particle mixing

Applications include: Formulating and mixing a multitude of different products including, adhesives, sealants, moulding compounds, lubricants, cosmetics and pharmaceuticals or any other materials which are hard to mix, hard to degas, or hard to wet.

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