Cavro[®] Air Displacement Pipettor provides the key to automated sonochemical synthesis of nanoparticles

Go2 Technologies, a specialized engineering solutions provider, has used Tecan's Cavro Air Displacement Pipettor to develop a novel automated method for labor-intensive sonochemical synthesis procedures.

Go2 Technologies in Dayton, Ohio, USA, has taken advantage of state-of-the-art manufacturing and engineering technology, combined with leading-edge robotics and the Cavro Air Displacement Pipettor (ADP), to establish an innovative automated process for sonochemical synthesis of nanoparticles for the generation of hydrogen gas. Sonochemical synthesis – chemistry driven by ultrasound waves – relies on high intensity sound waves, which are only present near a powerful sonic probe. This makes it difficult to perform large-scale reactions and, as a result, chemists are usually forced to perform labor-intensive batch procedures consisting of numerous small syntheses. To automate these procedures – and decrease labor costs significantly – Go2 Technologies has developed the RADS robotic synthesis machine. Kent Walker, Partner/Owner at Go2 Technologies, explained: "The University of Dayton Research Institute and the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, were creating air-stable organically-capped aluminum nanoparticles for the production of hydrogen gas from water, which involved manually pipetting three different materials – alane, titanium isopropoxide, and oleic acid – inside a glovebox. This is a very labor-intensive procedure for a single operator, and we were approached to develop an automated method that could robotically dispense, mix, sonicate and verify, essentially to produce a robotic synthesis machine to automate the manual pipetting and dispensing stages within the enclosure."



The robotic arm holds the Cavro ADP

"The really big challenge of the whole process was liquid dispensing; we needed something compact and lightweight that could cover a large range of volumes, from 15 μ l to 10 ml. Some of the chemicals used are pretty harsh on plastics, and pumping these materials through a mechanical piece of equipment was causing them to degrade and break down quickly. This was where the Cavro ADP really came into play. We looked at standard dispensing-type pumping systems but, typically, these wanted to bring the liquids into the device. The nature of the liquids used meant that we needed to find a non-contact mechanism for dispensing and pumping, with tips that were either disposable, or could be removed and replaced during the process.

Accurate, reliable dispensing of liquid volumes was also vital. I had previous experience with Tecan and was familiar with its products, so we approached Tecan Systems. The Cavro ADP was the key to making the whole dispensing process happen because it doesn't touch the liquid, it just brings it into the end of a disposable pipette tip."

Kent continued: "The system design is unique. Unlike the more standardized XYZ robotic components, the Cavro ADP is free standing and is manipulated by a Mitsubishi vertical articulating robotic arm. The Cavro ADP needed to be used as a pick and place-type unit rather than being permanently mounted, so we created custom fixtures and tools from "The Cavro ADP has been vital to the success of the project."



From left to right: Kent Walker, Scott Schoessow and Allen Poe from Go2 Technologies

which the robotic arm could pick it up when required. We use the Cavro ADP with Tecan's disposable tips, and have modified the tip racks to fit our application. Each of the liquids that we pipette has its own rack of tips and, once they have been used, we just dispense them into a waste container within the purge box. All these adaptations had to be extremely precise, to ensure that everything worked reliably and reproducibly."

"As well as implementing the robotic solution, we had to develop a custom airtight chamber that could be purged with nitrogen. After talking to several vendors about the inner chamber we realized that these products were so standardized that they really didn't fit our solution, and so we designed and built the purge box ourselves. This stainless steel enclosure was specifically sized to house all the equipment required, including the vertical articulating arm, the Cavro ADP, and the reagents, vials and trays. We had to allow sufficient space for the robotic arm to operate – pipetting with the Cavro ADP, capping and uncapping vials and moving them to a sonic probe – and to accommodate any cables."

"We can now perform batch processing of samples by placing them in individual vials inside the glovebox, and process an entire grid of these vials in one run. A batch of up to 56 vials can be processed, with each one taking around 20 minutes to complete. You just load the cell, close the box and purge it with nitrogen, then start the run



The robotic arm manipulates the Cavro ADP within the purge box

and walk away. Consistency is essential for the synthesis to work, and the Cavro ADP has been vital to the success of the project," concluded Kent.

To find out more on Tecan's Cavro ADP, visit **www.tecan.com/components**

To find out more about Go2 Technologies, visit **www.go2technologies.com**