



Discovering a Hyper-Cross-Linked Polymer for CO₂ Capture

The Centre for Materials Discovery
Uses *Micromeritics'* Instrumentation

BUSINESS CASE STUDIES



Micromeritics®: A Partner for Professor Cooper's Materials Discovery Research

Professor Andrew Cooper of the University of Liverpool and founding Director of the Centre for Materials Discovery is known for his outstanding contributions to the design and discovery of a range of functional materials.

Since obtaining his PhD in 1994, he has gone on to achieve multiple awards and accolades, and he has recently been elected Fellow of the Royal Society. With multiple research endeavors, Professor Cooper leads a large research group with diverse research aims. Currently, his main research focus is aimed at developing new porous organic materials from atomic to macroscopic sizes, for energy-related applications.

The overall core goal of the research group is to make materials with structures and functionalities that are not found in other systems. Under his guidance his research teams are interested in functional materials and how they can be utilized to address the current energy crisis that we are faced with.

To perform cutting edge research, and measure the structure and function of newly developed materials, reliable instrumentation and expert knowledge is required. Within academia it is vital for accurate and meaningful results to be achieved in as short a time as possible, to ensure publication of original findings in high-impact journals, maintain credibility and obtain further grants and funding.

For 15 years, Professor Cooper has partnered with Micromeritics. The collaboration provides Professor Cooper with a powerful solution, encompassing expert teams and tools. His researchers can be confident that results are reliable and that technical assistance is available at any stage of the process should it be required.

Strong foundations have been laid allowing Professor Cooper and his teams to reach conclusions quickly and as a result publish research in high level journals including Nature, Nature Materials and Journal of the American Chemical Society.

"We do fairly unusual experiments that are not standard," said Professor Cooper. "The relationship we have with Micromeritics allows us to perform these studies with confidence. We haven't had many problems, however any issues have been solved quickly, which is important to us, and I think this is where Micromeritics is very impressive."



"We have found the Micromeritics instruments to be the most versatile and reliable. Combined with the technical expertise offered and subsequent collaborations with Micromeritics staff, we are provided with a complete solution for our research," said Professor Cooper.

Micromeritics is more than ‘just a service provider’

Within the Centre for Materials Discovery, Professor Cooper researches functional materials and how they can be used to address the energy situation we are currently faced with. Carbon capture storage (CCS) represents a rapidly developing set of technologies including pre-combustion capture, post-combustion capture and oxyfuel combustion capture. The technique has the potential to achieve >90% reductions in CO₂ emissions,¹ and is a very prominent area of research, however there is a challenge. To render CCS technologies competitive against renewables and nuclear power, significant cost reductions are required. Therefore the materials for CCS must be inexpensive, robust, and able to absorb CO₂ selectively from a mixture of other gases.

In 2014, Professor Cooper explored the use of hyper-cross linked polymers as sponges to chemo-selectively adsorb CO₂.² Professor Cooper’s research received extensive media coverage, as the hyper-cross linked polymers had the potential to bridge the gap between the overuse use of fossil fuels and new energy sources such as hydrogen.

The research was highly praised, however obtaining the results did not come without its challenges. “The measurements that we performed on the hyper-cross linked polymer were completed in the presence of water, which is extremely challenging, and without the help of Micromeritics we couldn’t have successfully conducted the analysis,” said Professor Cooper. “We were introduced to Jason Exley from Micromeritics by the UK Country Manager when we required advice, and subsequently we partnered on the research, and co-authored the paper titled ‘Swellable Water- and Acid-Tolerant Polymer Sponges for Chemoselective Carbon Dioxide Capture’. Due to Jason’s technical knowledge, he was able to contribute to methods of performing the analysis, to produce favorable results, and without Jason we couldn’t have performed the analysis. Our collaboration with Jason is a strong example of how partnering with Micromeritics has positively influenced our research outcomes,” said Professor Cooper.

“Without collaborating with Jason Exley from Micromeritics, we wouldn’t have been able to successfully publish our research paper in The Journal of the American Chemical Society,” said Professor Cooper.



Micromeritics Instruments are the Most Reliable and Versatile

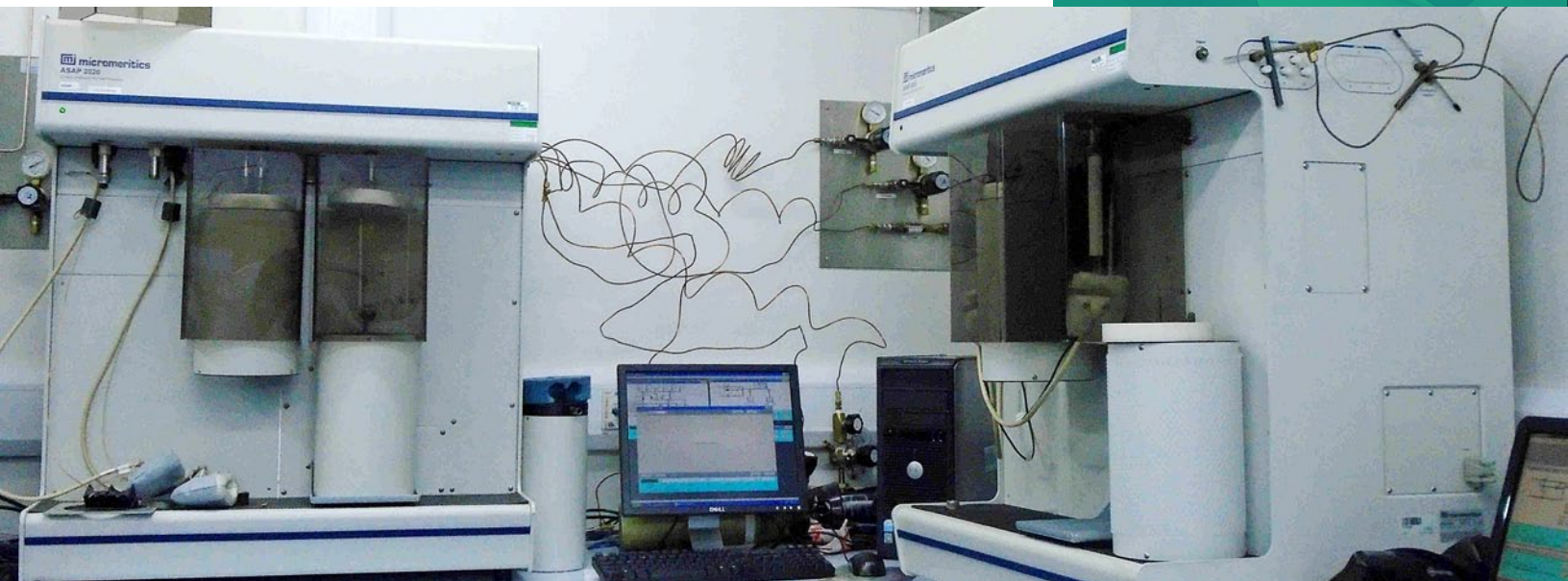
Within academia, publication of research results and conclusions within high level journals is essential to attract further funding and maintain research standards. In order to be successful, the data produced has to be robust and reproducible and must be published in a timely fashion. In a research group as large as Professor Cooper's it is imperative that instrumentation produces reliable results, is easy to use, and that vital time is not wasted dealing with problems and breakdowns. "Having a reliable instrument that you know that works and will not let you down is very important. It can be disastrous if anything should go wrong, as we quite often have papers where we have a month to make revisions and respond to comments. If this is not completed within the allotted time, then the paper may not get accepted," said Professor Cooper.

"Our lab has chosen to utilize multiple Micromeritics instruments for an extended period of time, due to our favorable experience using the systems. Due to the nature of our research, we use an array of instruments. The ASAP® 2420, has allowed us to look at

multiple samples at the same time, and has become a workhorse, as it is especially good for materials discovery. We also make use of the 3Flex 3500, coupled with a cryostat so that we are able to control the temperature. This piece of equipment is invaluable, and everyone wants to use it."

"The instruments are relatively maintenance free, which is extremely beneficial, and is not always the case with other providers. Coupled with this, the software is simple and straightforward to use, meaning PhD students can quickly learn how to carry out the protocols and procedures. As well as the instruments being easy to use, they are also extremely reliable, and we rarely experience problems with the instrumentation. On the rare occasion that we have had a breakdown, Micromeritics have been quick to respond and fix any problems. We work in a very competitive area. Porous material research is continually growing, and completing research quickly is essential. We have found the Micromeritics instruments to be the most versatile and reliable, and they truly meet our research needs."

"We use multiple instruments from Micromeritics, including the ASAP® 2420 which has become a workhorse within our lab, and also the 3Flex, which is a popular instrument that everyone wants to use," said Professor Cooper.



Conclusion

Materials discovery expert Professor Andrew Cooper has highlighted the excellence that you can expect when partnering with Micromeritics. In combination with innovative and reliable instruments, the extensive technical expertise of the in house scientists can make a positive and significant impact to research, as demonstrated with the paper that was co-authored with Jason Exley.

Professor Cooper partners with Micromeritics, and in doing this he receives not only high-quality instruments, but a support system to help his research for publication high level journals. The positive results obtained from the collaborative research, lay a solid foundation for future research, and potential applications to life outside the lab, all of which wouldn't have been possible without the help of Micromeritics.

If you are looking for a strategic partner for your materials discovery research, then why not consider how partnering with Micromeritics can enhance your research and help you to meet your aims and objectives?



1. Haszeldine R.S (2009). Carbon Capture and Storage: How Green Can Black Be? *Science* 325: 1647-1652.
2. Woodward R.T., Stevens L.A., Dawson R., Vijayaraghavan M., Hasell T., Silverwood I.P., Ewings A.V., Ratvijitvech T., Exley J.D., Chong S.Y., Blanc F., Adams D.J., Kazarian S.G., Snape C.E., Drage T.C., and Cooper A.I. (2013). Swellable, Water- and Acid-Tolerant Polymer Sponges for Chemoselective Carbon Dioxide Capture. *Journal of the American Chemical Society* 135: 9028-9035



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