

A bumper year for customer publications!

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2019 was another bumper year for Hiden Isochema customer publications. In this issue, we feature some recent highlights.

Harvesting water with MOFs

In an article published in the Journal of the American Chemical Society^[1], researchers from Massachusetts Institute of Technology (MIT), USA, used a XEMIS analyzer to measure water uptake by a series of MOFs for water harvesting and related applications. Samples weighing only 5 mg were used to measure high quality water sorption-desorption isotherms at multiple temperatures, as well as to perform long term cycling studies to demonstrate the stability of the materials. The effect of various anions on the MOF properties were discussed in terms of hydrogen bonding and porosity.

Removing harmful gases with MOFs

Researchers from the University of Manchester, UK, meanwhile, used XEMIS, IGA and ABR analyzers to study two novel MOFs for environmental applications, in articles published in Nature Materials^[2] and Nature Chemistry^[3]. The first describes the reversible binding and separation of sulfur dioxide by the MOF MFM-170^[2] and explains how these properties are both environmentally and economically beneficial. The data include high resolution SO₂ adsorption-desorption isotherms at seven temperatures, as well as stability testing over 50

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adsorption-desorption cycles with no loss of capacity. The second describes the capture of nitrogen dioxide and its conversion to nitric acid by the MOF MFM-520 [3]. The authors describe how the adsorbed NO_2 molecules dimerize reversibly to N_2O_4 and demonstrate that the captured NO_2 can be readily and completely converted to nitric acid, HNO_3 , by treatment with water in air.

A collaborative study led by researchers from the Department of Chemical Engineering at Imperial College London, UK, investigated the use of various complementary adsorption measurement techniques to screen a number of MOFs for their dynamic CO/N_2 separation properties [4]. The wide ranging study used CO and N_2 sorption isotherms, measured using an IGA-001, which were further analyzed to obtain adsorption enthalpy values. The isotherms were also used to calculate selectivity.



Improving alloy activation for H_2 storage

In a different application area, customers at the University of Bourgogne Franche-Comte, France, employed an IMI-HTP for a detailed study of a TiFe-based alloy for hydrogen storage, published in *Materials Research Bulletin* [5]. Methods for improving the activation of the alloy were investigated, with the activation process, as well as the pressure-composition isotherms, being programmed using the IMI-HTP. As well as the activation curves and hydrogen sorption isotherms, isobaric absorption and desorption kinetics were also analyzed.



Characterizing polymers for gas separations

An article by researchers from the National University of Singapore [6] describes the impact of various chemical functional groups on the gas transport properties of six related polyimides. A XEMIS-001 was used to measure CO_2 and CH_4 gas solubility, with the authors also comparing the permeability and selectivity for the various polyimide membranes studied.

Synthesis and characterization of a novel hypercrosslinked polymer for the separation of propane and propene was reported recently by researchers from the University of Liverpool, UK [7]. Breakthrough curves for different propane/propene mixtures at several temperatures were measured using an ABR and the stability of the polymer demonstrated by repeated breakthrough-desorption cycling. The authors identify the potential use of hypercrosslinked polymers for olefin/paraffin separations due to their robust and low cost synthesis and performance.



References

- [1] A. J. Rieth et al, *Journal of the American Chemical Society* (2019) 141, 13858-13866. DOI: 10.1021/jacs.9b06246
- [2] G. L. Smith et al, *Nature Materials* (2019) 18, 1358-1365. DOI: 10.1038/s41563-019-0495-0
- [3] J. Li et al, *Nature Chemistry* (2019) 11, 1085-1090. DOI: 10.1038/s41557-019-0356-0
- [4] A. D. Evans et al, *Industrial & Engineering Chemistry Research* (2019) 58, 18336-18344. DOI: 10.1021/acs.iecr.9b03724
- [5] A. Zeaiter et al, *Materials Research Bulletin* (2019) 112, 132-141. DOI: 10.1016/j.matresbull.2018.12.015
- [6] S. Japip et al, *Industrial & Engineering Chemistry Research* (2019). DOI: 10.1021/acs.iecr.9b04713
- [7] A. Stephenson et al, *Journal of Materials Chemistry A* (2019) 7, 25521-25525. DOI: 10.1039/c9ta07510k
- [8] M. Lacuve et al, *Polymer Degradation and Stability* (2019) 168, 108949. DOI: 10.1016/j.polymdegradstab.2019.108949
- [9] A. Dahi et al, *Journal of Molecular Liquids* (2019) 292, 111109. DOI: 10.1016/j.molliq.2019.111109

Studying water solubility and transport in polymers and molecular liquids

The water vapor solubility and diffusivity of three vulcanized ethylene propylene diene monomer (EDPM) based polymers was studied using an IGA-sorp-CT by researchers at ParisTech, France^[8]. Water sorption isotherms and corresponding water sorption kinetics at 70 °C between 0 and 95 %RH were presented with the sorption kinetics fitted to diffusion models. The results were discussed in terms of water clustering in different humidity regimes.

Researchers at the University of Rouen, France, used an IGA-sorp-CT to perform a detailed study of the water sorption properties of a representative pyridinium-based ionic liquid^[9]. The water sorption equilibrium and kinetic measurements were performed over the full water activity (humidity) range up to 95 %RH. Water sorption results were evaluated in terms of water clustering and the molecular state of water determined from infrared spectroscopy.



A decade in review

2011

IMI series launched

High accuracy manometric gas sorption analyzers redesigned to cover application areas including CO₂ capture, natural gas storage and nanoporous materials characterization.



2013

New headquarters opens

A purpose-built 15,000 sq. ft. manufacturing facility in Warrington, England. With new product development, manufacturing, demonstration and contract analysis laboratory facilities.



XEMIS launched

A new high accuracy sorption analyzer with next generation microbalance designed for high pressure and corrosive capability, allowing a combination of conditions not previously achievable with commercial gravimetric sorption analyzers.

2015

1000 Companies to Inspire Britain

Hidden Instruments was named in the report by the London Stock Exchange. It celebrated the UK's fastest-growing and most dynamic small and medium sized businesses.

ABR launched

A unique fully automated breakthrough analyzer with integrated mass spectrometry.



2017

MBR launched

A dedicated membrane testing reactor for studying the selective gas permeation properties of membrane materials for separation and purification applications, is launched.



2016

IGA-sorp XT launched

Designed for measurements at temperatures and humidities beyond those available with conventional DVS analyzers.



2018



Expansion of the company headquarters

Further expansion due to continued growth including expanded office space and new clean room facilities.

2019

IGA-003-MC launched

Using the newly developed IMB method, the instrument provides a breakthrough in measuring binary gas adsorption isotherms rapidly and on small sample sizes. The method is unique to Hidden Isochema.



For further information please contact our Sales and Application team at info@hiddenisochema.com

IMB talk a hit in Orlando

In mid-November, Hiden Isochema product manager, Dr Darren Broom, gave a well-received talk at the American Institute of Chemical Engineers (AIChE) Annual Meeting in Orlando, USA. Based on a collaboration with Professor Orhan Talu from Cleveland State University, USA, this was the first time our new Integral Mass Balance (IMB) method for measuring multicomponent gas sorption by nanoporous materials was presented to the public.

Developing more efficient methods for measuring multicomponent gas adsorption is important because traditional approaches tend to be time-consuming and require large sample sizes. The IMB method, which is unique to Hiden Isochema's **IGA-003-MC** gas sorption analyzer,



offers an automated and rapid way of measuring binary gas adsorption on samples weighing only a few grams. It combines a flowing system with in-situ gravimetric measurement and a dynamic sampling mass spectrometer, to allow measurement of multipoint binary adsorption isotherms in only a matter of hours. For further information, please contact our applications team on info@hidenisochema.com.



Gas Adsorption Summer School a great success!

Hiden Isochema was a proud sponsor of the 1st International Gas Adsorption Summer School (IGASS), which was held on the Greek island of Spetses from the 9th to the 13th September 2019.

The school attracted approximately 40 students, from as far afield as Australia and Canada, and featured a five day programme of talks and tutorials on various aspects of gas adsorption. A total of eight tutors delivered the programme, on topics including adsorption fundamentals and applications, measurement techniques, and characterizing the porous properties of materials using gas adsorption.

This first international school was a great success, thanks both to the contributions of the sponsors, tutors and students, and the excellent organization provided by Theodore Steriotis, Georgia Charalambopoulou, and their team from the National Center for Scientific Research "Demokritos" in Athens, Greece. This success means a second school – hopefully the start of a series – is highly likely to be held in the future. We very much hope that IGASS will then become a regular fixture on the calendar of adsorption conferences and meetings.

Discovering more. seeing more.

DATE	CONFERENCE	LOCATION
30-31 Jan	AFA French Adsorption Association	Paris, France
22-26 March	ACS Spring	Philadelphia, USA
TBC	Pan-Hellenic Porous Materials Symposium	Athens, Greece
18-20 May	13th Brazillian Meeting on Adsorption EBA 13	Fortaleza, Brazil
25-28 May	Interpore	Qingdao, China
7-10 June	COPS-XII	Bath, UK
12-15 July	FEZA 2020	Brighton, UK
12-17 July	ICOM 12th International Congress on Membranes and Membrane Processes	London, UK
20-23 Sept	MOF 2020	Dresden, Germany
1-7 Nov	MH2020	Perth, Australia
15-20 Nov	AIChE Fall Meeting	San Fransisco, USA