ANALYZER
HIDEN ISOCHEMA NEWSLETTER
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A BUSY YEAR 2018

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hidenisochema.com /blog

This year saw Hiden Isochema attend a record number of scientific meetings and conferences. It has taken us all over Europe, and to the USA, China, Japan, South Africa and New Zealand.

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YEAR ROUND-UP

We've covered application areas as diverse as food science, pharmaceuticals and crystal engineering, timber research, geosciences, porous material characterization, and both chemistry and chemical engineering.

This has given us a fantastic opportunity to meet our existing customers and collaborators, but also to introduce our product ranges to new audiences. As well as exhibiting, we contributed presentations to the British Zeolite Association (BZA) Annual Meeting in Ambleside, UK, and to the French Interpore Chapter meeting in Nantes, France.

'Materials science facing global warming – practical solutions for our future'

Dr Darren Broom, Hiden Isochema Product Manager, was invited to speak at an adsorption summer school at the University of Strathclyde, and at the International Workshop on Porous Materials and their Applications (IWPMA-2018), which was hosted by Dr Henrietta Langmi and Dr Nicholas Musyoka of the Council for Scientific and Industrial Research (CSIR) in Pretoria, South Africa. Darren was also a Session Chair at the MRS Fall 2018 symposium 'Materials science facing global warming – practical solutions for our future', and is currently one of six UK representatives on the International Energy Agency Hydrogen Implementing Agreement (IEA-HIA) Task 32 'Hydrogen-based Energy Storage', attending meetings this year in both Venice, Italy, and Guangzhou, China.

Dr Andraž Krajnc
National Institute of Chemistry

We were also very pleased to be able to offer a free delegate registration to MOF2018, held in Auckland, New Zealand, from 9-13th December. We had a fantastic response to our request for applications, and eventually awarded the place to Dr Andraž Krajnc of the National Institute of Chemistry in Ljubljana, Slovenia. His recent work has included the study of the performance of microporous aluminophosphates for use in water sorption-based energy storage and transformation, and he will soon begin work on the use of nanoporous materials, such as MOFs, for water harvesting applications.

NEW REVIEW ARTICLE:

Gravimetric Gas and Vapor Sorption Measurements

A detailed review article, entitled 'Gas and Vapor Sorption Measurements using Electronic Beam Balances', has recently been published by Hiden Isochema customers at the University of Kansas.

The group, headed by Prof. Mark Shiflett, is a center of excellence for gravimetric sorption analysis with gas and vapor species on diverse materials ranging from porous solids such as carbons and zeolites, through polymer membranes, to ionic liquids and related liquids.

The review covers the historical development of beam balances from ancient times through to modern electronic microbalances, and explores the application of the gravimetric technique in high accuracy automated gas and vapor sorption analyzers. Three Hiden Isochema product lines are reviewed; IGA, IGAsorp and XEMIS and their application across a wide range of pressures discussed, with examples drawn from the literature.

"We expect that the review will be an extremely valuable resource for researchers in many diverse fields!"

D. Minnick et al, J. Vac. Sci. Technol. A, 36 , 050801 (2018).

Science

RESEARCH REPORT
Science (2018) 362, 443-446

Ethane/ethylene separation in a metal-organic framework with iron-peroxo sites

L. Li, R.-B. Lin, R. Krishna, H. Li, S. Xiang, H. Wu, J. Li, W. Zhou and B. Chen

A recent research article in *Science* reports highly selective separation of ethane, C_2H_6, from ethylene, C_2H_4, using a microporous metal-organic framework (MOF) under near ambient conditions. An **IGA-001** was used to measure high resolution sorption-desorption isotherms for the single component gas species on the MOF, $Fe_2(O_2)$(dodbc), and the selectivity obtained from Ideal Adsorbed Solution Theory (IAST) calculations compared with results of breakthrough curve measurements. The team from Taiyuan University of Technology, Shanxi, China, and their collaborators in USA, Europe and elsewhere in China, comment that the MOF's selectivity for ethane over ethylene from a 50/50 mixture at 298 K sets a new benchmark for performance, which is sustained over 5 cycles. The ability to produce polymer grade ethylene from a mixed ethane/ethylene stream without energy intensive cryogenic processes is significant and will be investigated further!

BOOK PUBLISHED:

Gas Adsorption in Metal-Organic Frameworks

A new book, entitled 'Gas Adsorption in Metal-Organic Frameworks: Fundamentals and Applications', has just been published by CRC Press.

Edited by Dr Grant Glover of the University of South Alabama and Dr Bin Mu of Arizona State University, the book covers a number of different aspects of metal-organic frameworks (MOFs) and their gas adsorption properties and applications.

Early chapters discuss the synthesis and characterization of MOFs, the thermodynamics of adsorption, diffusion processes, and the dynamics of adsorbent beds, as determined from breakthrough curves. Later chapters address the simulation of nanoporous materials and adsorption/diffusion, characterizing MOFs using a range of physical and chemical techniques, and their water stability, which is of fundamental importance in gas adsorption applications. The final three chapters cover the applications themselves, including gas storage, toxic gas filtration and removal, and gas separation.

Gas Adsorption in Metal-Organic Frameworks: Fundamentals and Applications therefore provides a comprehensive overview of the synthesis, characterization, and gas adsorption applications of MOFs. It should appeal to any readers interested in the topic, including both chemists and chemical engineers, in academia or industry; but its coverage of the basics of gas adsorption by metal-organic frameworks, combined with discussion of the recent literature, should help new graduate students, in particular, gain an excellent grounding in the subject.

1st International Gas Adsorption Summer School

Hiden Isochema is pleased to be supporting the 1st International Gas Adsorption Summer School (I-GASS) which will be held on the Greek island of Spetses from 9-14th September 2019.

Its aim is to provide an introduction to the measurement and analysis of gas adsorption by nanoporous materials, targeted at graduate (PhD) students and young scientists and engineers, from both academia and industry, who are new to the field.

The interest in synthesis of novel nanoporous materials as well as their applications is rapidly expanding and continuously attracts newcomers from diverse research disciplines. Gas separation and storage are key applications, while adsorption is routinely used to study the structure and assess the potential of new materials.

The five day programme will introduce nanoporous materials, the fundamentals and applications of gas adsorption, and the measurement methods typically used to determine the gas adsorption behaviour of porous solids. Approaches to analysing adsorption data for applications, such as gas storage and separation, and for assessing the pore structure of porous materials will also be covered. There will be an emphasis on making accurate measurements and applying the most appropriate models to adsorption data.

The programme will mix formal lectures with tutorials and group work, and allow plenty of time for informal discussion.

The summer school is being launched by an international team of adsorption experts, while local organization efforts will be led by Dr Theodore Steriotis (National Center for Scientific Research "Demokritos", Athens, Greece).

For more information visit the conference website at: i-gass.gr

REACH OUT TO US:

DATE	CONFERENCE	LOCATION
11-15 March	6th International Conference on Multifunctional, Hybrid and Nanomaterials	Sitges, Spain
31 March - 4 April	ACS Spring Meeting	Orlando, USA
30 April - 1 May	Making Pharmaceuticals	Coventry, UK
6-10 May	Interpore Annual Meeting	Valencia, Spain
21-23 May	Japan Adsorption 2019	Chiba, Japan
26-31 May	FOA13 (Fundamentals of Adsorption)	Cairns, Australia
30 June - 5 July	Gordon Research Conference on Hydrogen - Metal Systems	Castelldefels, Spain
1-2 July	UK Porous Materials Conference	Cardiff, UK
8-11 July	MC14 (RSC Materials Chemistry)	Birmingham, UK
14-19 July	Carbon 2019	Kentucky, USA

PUBLICATION ROUND-UP

COFs

Sulfone-containing covalent organic frameworks for photocatalytic hydrogen evolution from water.

X. Wang et al.

Nature Chemistry (2018)
DOI: 10.1038/s41557-018-0141-5

Researchers at the University of Liverpool and their collaborators describe the use of covalent organic frameworks (COFs) as photocatalysts for water splitting, with remarkably high quantum efficiency for an organic photocatalyst. Three crystalline COFs were synthesised and characterised to determine their porosity and affinity for water, as well as their photocatalytic behaviour.

An **IGA-002** was used to measure water adsorption-desorption isotherms for the COFs, which each exhibited Type-II sorption behaviour. The best performing material for photocatalytic water splitting, fused silica COF (FS-COF), also exhibited the highest water sorption uptake capacity, and the greatest hysteresis between adsorption and desorption isotherms.

MOFs

Ammonia Storage by Reversible Host–Guest Site Exchange in a Robust Metal–Organic Framework.

H. G. W. Godfrey et al.

Angewandte Chemie (2018)
DOI: 10.1002/ange.201808316

Chemists at the University of Manchester report NH_3 adsorption as a method of safe ammonia storage and transport, using their metal-organic framework MFM-300(Al) as the adsorbent. The ability of MFM-300(Al) to selectively adsorb NO_2, measured with a XEMIS-001, was previously featured in Issue 04 of Analyzer [1]. In this new research, the authors use neutron scattering, FTIR microscopy and gas adsorption-desorption measurements to characterise the reversible ammonia adsorption properties of the material. A **XEMIS-001** was used to record adsorption-desorption isotherms at four temperatures in the range 273-303 K, and also to study NH_3 sorption-desorption kinetics and capacity over 50 cycles at 293 K. No loss of NH_3 capacity or crystallinity was detected over the 50 cycles.

1. X. Han et al, Nature Materials (2018), 17, 691-696.

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