

First Quarter 2007

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# SIGMA-ALDRICH ACQUIRES EPICHEM GROUP

Dear Customer,

Epichem is pleased to inform you that in February we signed a definitive agreement to sell all shares to Sigma-Aldrich Corporation to expand their growing SAFC Hitech business segment. SAFC is considered a top 10 fine chemical company and is focused on the custom manufacture of high-quality, specialty chemicals for organizations developing and commercializing new products.



SAFC Hitech has expressed a strong desire to build upon what Epichem has worked so diligently to create, and brings financial strength as well as extensive large-volume manufacturing expertise in novel chemistry, solid scale-up experience, a history of innovation, and a significant global supply chain network. This nicely complements Epichem's foundation of a robust product pipeline, experienced personnel and its unique collaborative application development approach.

Moving forward, I have been appointed as President of the SAFC Hitech business segment. For you, our valued customers, this acquisition will allow us to provide you with specialized high-quality materials that meet your demands and will strongly position us as a leading supplier and developer of new materials for the market. We offer:

- **An immediate increase in the breadth of our product portfolio**
- **Expanded global supply, service and distribution capabilities**
- **Strong commercial manufacturing capacity**
- **Further enhancement of our customer-centric collaborative R&D processes**
- **Enhanced new molecule development and process understanding**

Regarding immediate concerns you may have, please rest assured that our level of service to you will only improve. Your current account manager and contacts will remain the same and your chemists can expect to be supplied with material from the locations they are using today. Please contact me or your local account manager if you require additional details immediately.

Thank you for your past business. We look forward to servicing you in the future.

Best regards,

**Barry Leese**

Managing Director, Epichem  
President, SAFC Hitech

## Compounds

ALUMINIUM  
ANTIMONY  
ARSENIC  
BARIUM  
BISMUTH  
BORON  
BROMINE  
CADMIUM  
CALCIUM  
CARBON  
CESIUM  
CHLORINE  
CHROMIUM  
COBALT  
COPPER  
GALLIUM  
GERMANIUM  
HAFNIUM  
INDIUM  
IODINE  
IRON  
LANTHANUM  
LEAD  
MAGNESIUM  
MANGANESE  
NICKEL  
NIOBIUM  
NITROGEN  
PHOSPHORUS  
PLATINUM  
RUTHENIUM  
SCANDIUM  
SELENIUM  
SILICON  
STRONTIUM  
SULFUR  
TANTALUM  
TELLURIUM  
TIN  
TITANIUM  
TUNGSTEN  
VANADIUM  
YTTRIUM  
ZINC  
ZIRCONIUM

# Conference Representation for 2007

*Epichem continues its strong presence at key conferences and workshops*

Epichem personnel will again be at all the key conferences and workshops around the world to network with customers and the scientific community. As markets move forward we ensure state of the art products and services are available to groups across a wide spectrum of application areas to offer a competitive advantage for the end user. We are pleased to invite you to come and talk to a representative at one or more of the events listed below planned for 2007. Come for a chat about sales enquiries, technical support or the weather back home, everyone is welcome.

Date	Conference	Location
February 18-21	WOCSEMMAD 07	Savannah, USA
March 21-23	Semicon China	Shanghai, China
April 17-19	Blue Conference - SSSL Forum	Hsinchu, Taiwan
April 17	BCGA Conference	Oulton, UK
May 6-11	211th Electrochemical Society (ECS) Meeting 2007	Chicago, USA
May 8-12	ISIF 2007 International Symposium on Integrated Ferroelectrics	Bordeaux, France
May 14-18	IPRM 19th International Indium Phosphide & Related Materials	Matsue, Japan
May 17	UKNC Open Day	London, UK
May 21-25	Industry and Enterprise Week Catalyst Museum	Widnes, UK
May 28-June 1	E-MRS Spring Meeting	Strasbourg, France
June 3-6	EW-MOVPE XI (12th European Workshop on Metalorganic Vapour Phase Epitaxy)	Bratislava, Slovakia
June 5-7	International Interconnect Technology Conference (IITC) 2007	San Francisco, USA
June 11-12	18th Annual IEEE/SEMI Advanced Semiconductor Manufacturing Conference (ASMC)	Milan, Italy
June 18-19	Semiconductor (S2K)	Cardiff, UK
June 20-22	EMC (Electronic Materials Conference)	Indiana, USA
June 20-23	The 15th INFOS 2007 Conference ("Insulating Films on Semiconductors")	Athens, Greece
June 24-27	ALD 2007	San Diego, USA
July 2-5	MC8: Advancing Materials by Chemical Design	London, UK
July 4-5	UK Compound Semiconductors 2007	Sheffield, UK
July 16-20	Semicon West	San Francisco, USA
July 17	CVD Network Meeting	Salford, UK
August 12-17	OMVPE	Salt Lake City, USA
August 29-31	The Scale Up of Chemical Processes	Boston, USA
September 3-4	BACG	Dublin, Ireland
September 3-7	22nd European Photovoltaics	Milan, Italy
September 3-8	The 17th FEICHEM	Sofia, Bulgaria
September 12-14	Semicon Taiwan	Taipei, Taiwan
September 16-21	EUROCVD-16	The Hague, Netherlands
September 17-21	ICNS - 7th International Conference on Nitride Semiconductor	Las Vegas, USA
September 17-21	E-MRS Fall Meeting (BALD 2007)	Warsaw, Poland
October 9-11	Semicon Europa 2007	Stuttgart, Germany
October	Semi European Standards Autumn Conference and Meetings	
October 9-11	Advanced Metallization Conference	Albany, USA
October	Compound Semiconductor Week/CS MAX	
November 27-29	MRS Fall Meeting	Boston, USA
December 5-7	Semicon Japan	Makuhari Messe, Japan
December	DGKK at the University of Marburg - organiser Wolfgang Stolz	Marburg, Germany
December	IEEE IEDM	Washington DC, USA

# Customer Satisfaction Survey Results

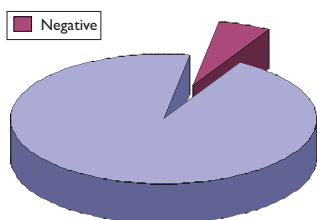
Epichem strives to achieve the highest standards of customer service and to assess performance in this area conducts an annual survey to allow customer perceptions to be evaluated. Feedback is highly valued and numerous improvement projects have been implemented based on customer feedback. The objective is to maintain this highly valued relationship with product users and ensure all areas of the Epichem / customer interface remain at the highest level.

The 2006/7 survey response has continued an increasing response trend with a record number of completed forms received. Epichem would like to thank all of the respondees for their time and comments which will be used to improve our performance. A prize draw was held for all completed forms and this year's winner of a state of the art iPod is Li Ren Chen from Hangzhou Silan Azure Co. Ltd based in China.



*Positive responses dominate survey results as Epichem surpasses expectations*

Summary of Responses

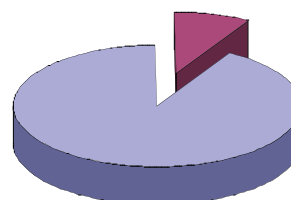


The findings of the survey allow corrective actions to be established to counter negative experiences as well as ensuring newly introduced protocols are successful. Positive feedback demonstrates that dealing with Epichem has surpassed customer expectations.

Overall the majority of responses were positive indicating an excellent perception of Epichem as a precursor supplier. The number of negative comments in all areas but one have reduced significantly when compared to previous years showing that policy changes based on prior survey results have been successful in resolving most of the issues highlighted.

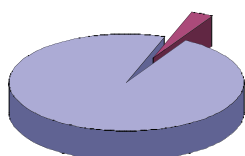
Further investigation of the area marked down, (is the product range wide enough?) revealed that the low perception related to a desire for alternative group V precursors due to other suppliers ceasing production and also to some available products that did not have sufficient profile in the product listings. New procedures will be introduced based on this year's findings to improve the dissemination of information concerning the total product range available. In particular all customers who returned negative comments will be contacted directly by their account manager to discuss these concerns and determine a strategic plan to resolve any difficulties. A key target for 2007 will be ongoing effective communication with the customer by all Epichem contacts. Furthermore a new look catalogue and website is hoped to further demonstrate the extensive options available in all application fields to ensure customers can purchase the precursors best suited to their processes in the most efficient manner.

Is the product range wide enough?

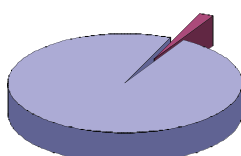


## Detailed results

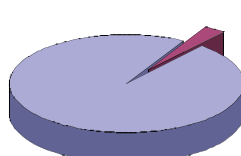
Are quotes handled effectively?



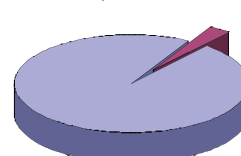
Is technical advice available and helpful?



Are complaints dealt with effectively?



Do products meet performance requirements?



Whilst customers whose complaints are satisfactorily resolved often become more loyal than customers who were never dissatisfied, it is Epichem's goal to reduce the number of complaints or concerns expressed by its customers and to increase the range and quality of service offered.

# CdCl<sub>2</sub> Halide Growth for Photovoltaic Solar Cells by MOCVD

*Supergen MOCVD partners dramatically improve solar cell performance using novel treatment approach*

The Optoelectronic Materials Research Laboratory at the University of Wales Bangor is part of a nationwide Supergen project funded by EPSRC titled "Photovoltaic Materials for the 21st Century". This project includes 6 universities and 7 industries including Epichem, together looking at a wide range of photovoltaic (PV) technologies from mono/poly-crystalline silicon to thin film Cl(G)S and CdTe. Our goal is to find novel and innovative routes to reduce the cost per watt in order to make it an affordable alternative energy source.

At the University of Wales Bangor, our primary research is to investigate and improve CdTe based solar cell using atmospheric pressure metal organic chemical vapour deposition (MOCVD). A simple example of such device structure is shown in Figure 1. CdTe is one of the contender materials for thin film PV solar cell with a near optimum direct band gap of 1.5 eV as well as low cost and abundance of raw materials. The p-n heterojunction is conventionally formed using cadmium sulphide (CdS) as a thin (~ 100 nm) window layer (n-type) and CdTe as the thick (~ 4 μm) absorber layer (p-type). As a consequence, both layers are polycrystalline with grain size of the order of the layer thickness. A crucial step, not represented in Figure 1, is the CdCl<sub>2</sub> treatment which has the effect of passivating the grain boundaries and provides a flux to promote lateral grain growth<sup>[1]</sup>.

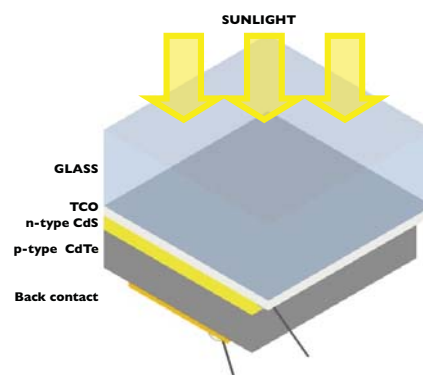


Figure 1 Superstrate configuration of a typical CdTe solar cell

We recently reported on the first deposition of CdCl<sub>2</sub> layers by MOCVD used for such photovoltaic solar cell<sup>[2]</sup>. As the p-n junction can be deposited by MOCVD, the *in situ* CdCl<sub>2</sub> treatment of the device allows for containment of the whole process. MOCVD allows a high level of control over material properties, currently using a real-time triple wavelength reflectometer, to monitor both wide and narrow band-gap semiconductor materials during growth. The precursors used for the deposition of CdCl<sub>2</sub>, provided by Epichem, are dimethylcadmium and tertiarybutylchloride respectively for the cadmium and chlorine species. The hygroscopic CdCl<sub>2</sub> was in its hydrate form once exposed to ambient air. Preliminary results on the whole MOCVD CdTe devices have shown that device efficiency above 10% can be reached, which is an encouraging result considering the best efficiency ever reported using conventional methods is 16.5%<sup>[3]</sup>. Using MOCVD, good device uniformity and good rectifying characteristics can be achieved and the repeatability is excellent.

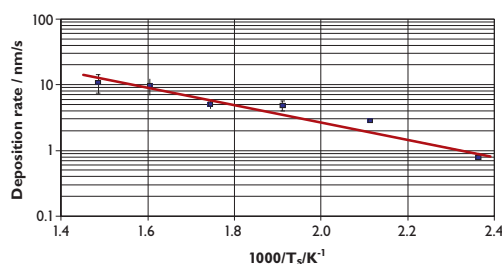


Figure 2 Arrhenius plot of the deposition rate of CdCl<sub>2</sub> on glass using DMCD and tBuCl as precursors in a total gas flow of 3500 sccm. The partial pressure of DMCD was 28.4 Pa with a II:VII precursor ratio of 0.29

From the Arrhenius plot in Figure 2, a low activation energy ( $E_a$ ) of the pyrolytic deposition of CdCl<sub>2</sub> was determined to be 25 kJ·mol<sup>-1</sup>. Varying the II:VII precursor ratio also seems to show that tBuCl acts as an autocatalyst. An extremely high growth rate, higher than 10 nm/s, has also been measured through cross-section SEM. CdCl<sub>2</sub> layers have 3 main growth regimes resulting in different microscopic surface morphologies, as seen in Figure 3. For a substrate temperature ( $T_s$ ) below 200°C, small grains evenly cover the surface, however, the lack of order is due to low surface mobility of Cd and Cl at these temperatures. For 200°C <  $T_s$  < 300°C, more coalescence of the grains occurs agglomerating into distinct islands. This deposition mechanism, confirmed by the *in situ* reflectometer, is characteristic of Volmer-Weber growth. At 300°C, equilateral triangle shaped islands indicate a crystallographic preferred orientation with 3-fold symmetry. The grain size reduces for  $T_s$  > 300°C which can be associated with re-evaporation of the CdCl<sub>2</sub> molecules given its high vapour pressure at these temperatures.

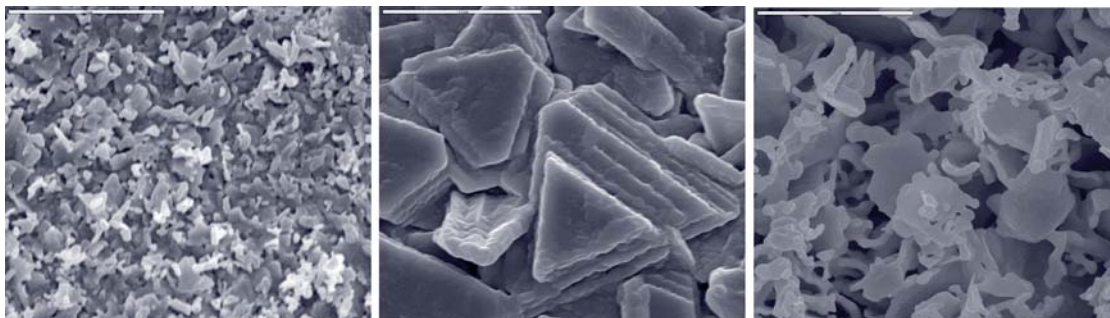


Figure 3 SEM micrographs of  $\text{CdCl}_2$  layers deposited on glass by MOCVD. The fixed parameters were: deposition time of 50 min, total gas flow of 3500 sccm, DMCD partial pressure of 28.4 Pa and II:VII precursor ratio of 0.29. The substrate temperatures during deposition were, from left to right: 150°C, 300°C, and 400°C. The markers are all 10  $\mu\text{m}$ .

Finally, the first deposition of  $\text{CdCl}_2$  by atmospheric pressure MOCVD, and its growth kinetic, was reported and offers great potential for an all-in-one process for production of solar modules by MOCVD. Furthermore, direct and/or indirect *in situ* doping of the semiconductor layers can be carried out effectively and controllably using MOCVD, which we believe will provide the key to the production of the next generation of such PV solar cells.

#### References

- [1] B E McCandless, K D Dobson, *Sol. Energy* **77** (2004) 839
- [2] V Barrioz, S J C Irvine, E W Jones, R L Rowlands, D A Lamb, *Thin Solid Films*, accepted for publication (proofs should arrive on the 4th January 2007)
- [3] X Wu, J C Keane, R G Dhere, C Dehart, D S Albin, A Duda, T A Gessert, S Asher, D H Levi, P Sheldon, *17th European PVSEC* (2001) 995

## Changes to the European Sales Team

2006 saw a change to the sales team in Europe with Jonas Andersson and Fab Support AB taking responsibility for the majority of customers. Reporting directly to Ann Hughes (Epichem European Sales Manager), Jonas has been involved with Epichem for many years and is already well known. Having spent two years in Brussels, Jonas is in April relocating back to his native Stockholm but is clearly only a short flight to anywhere on the continent to maintain customer contacts at the highest level. In the coming year he is planning a hectic schedule to meet with new and old customers and so will be in touch soon to arrange dates for visits.



Jonas Andersson

*Controlled in situ  
doping  
demonstrated to  
offer high potential  
for production  
process  
optimisation*

*A familiar face takes  
on more customers*

# MP2A as an Alternative Low Temperature Al Source

*New alane adduct with increased thermal stability shows promise in III-V growth*

The growth of Al-containing antimonides places particularly strict criteria on the Al source properties, namely it must decompose at low temperatures and must lead to low levels of C incorporation, a particular issue due to the strength of the Al-C bond. This is made worse by the necessity to use metalorganic sources for Sb due to the excessively low stability of hydride compounds ie  $\text{SbH}_3$ . The lack of hydrogen radicals at the growth surface, normally provided by group V hydride sources in III-V MOCVD, limits the mechanistic methods available for C removal and so the Al source must perform this function to compensate. The Al precursors usually employed for the growth of antimonides by MOVPE are  $\text{AlH}_3\cdot\text{NMe}_2\text{Et}$  (ADMEA) and  $\text{Al}(\text{tBu})_3$  (TTBA) and both provide active H on dissociation and can produce high quality layers, however some issues remain with these materials.

To improve performance of the promising alane adduct ADMEA an increase in stability was identified as desirable and so molecular tailoring of the ligand was investigated. Changing the ligand to methylpyrrolidine (MPA) was shown to be advantageous although the stoichiometry of the adduct was key to enhancing the stability of the molecule. In a reverse to normal experimental results for alane amine adducts the ratio of  $\text{AlH}_3\text{:MPA}$  found to be most stable was 1:2 with no decomposition or gas generated under standard usage conditions (see Figures 1 & 2).

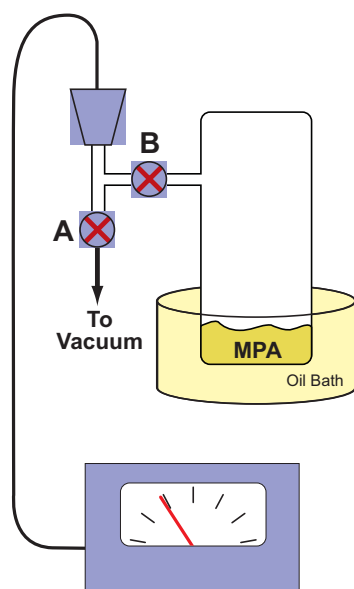


Figure 1 Stability trial set up

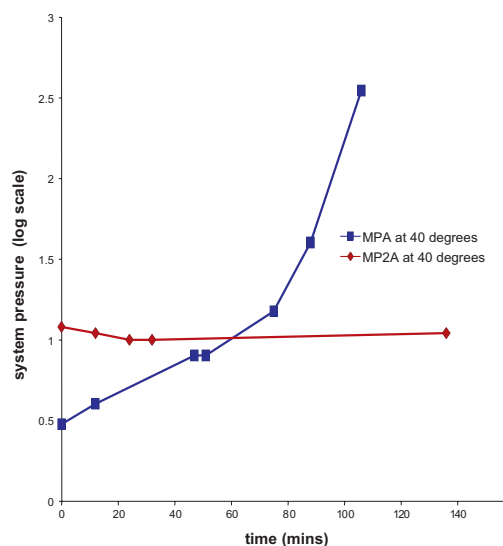


Figure 2 Decomposition data for MP2A vs MPA at 40°C

The vapour pressure of the  $\text{AlH}_3\cdot\text{MPA}_2$  (MP2A) was determined as comparable to ADMEA but still very low to achieve high growth rates in III-V MOVPE (see Figure 3). The potential to use higher temperatures for the source to boost transport rates and thus improve growth rates exists due to the increased stability of MP2A, however, in the growth studies detailed below operation at elevated temperatures was not possible due to kit constraints.

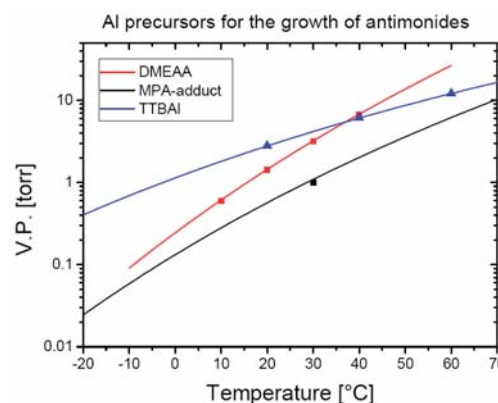


Figure 3 Vapour pressure comparison for MP2A, ADMEA and TTBA

Experiments were performed on the AIX2600-G3 MOVPE reactor with 9x2" substrate configuration at Fraunhofer-ISE. The MP2A bubbler was employed at the highest bath temperature of 17°C and the lowest pressure of 300 mbar with a hydrogen carrier gas mass flow rate of 0.45 sl/min to maximise transport. These conditions are very similar to those typically used for ADMEA and TTBA in this reactor. The growth temperature for AlGaSb was 575°C.

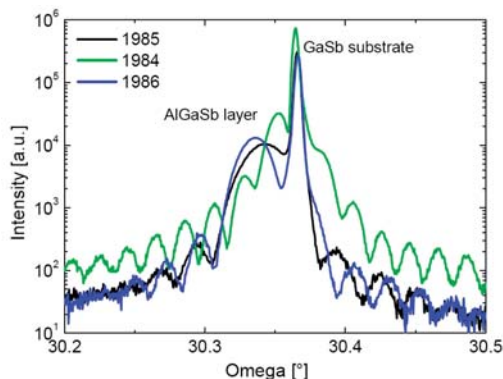


Figure 4 XRD data for Al<sub>x</sub>Ga<sub>1-x</sub>Sb films with 0.05 < x < 0.14 deposited using MP2A

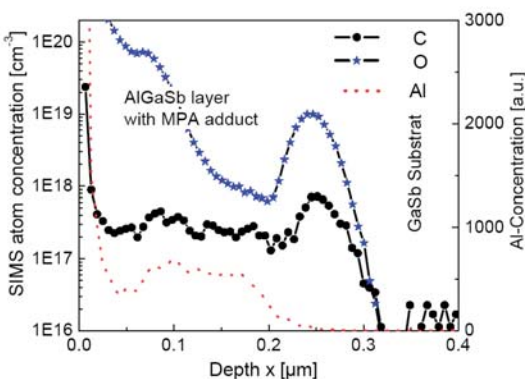


Figure 5 O and C SIMS data for AlGaSb film deposited using MP2A

The results on this system revealed AlGaSb can be deposited using MP2A, however, the growth rate was limited to 0.1 nm/s for Al concentrations x < 0.14 due to the parameters employed (see Figure 4). The purity of the precursor was evaluated by SIMS measurement of oxygen and carbon and found to be comparable to previous ADMEA data achieved on the same kit (see Figure 5). Note the high oxidation of the sample surface appears to penetrate deeply into the structure and through the thin AlGaSb layer.

The similarity between ADMEA and MP2A growth performance and purity is as expected and illustrates that the active component of the two sources is the same and the effect of the ligand is limited to the delivery of the precursor. As such the advantage of higher stability of MP2A remains to be fully exploited and it is expected that this source will be a promising antimonide precursor for the future.

*Growth results indicate high quality layers can be deposited using MOVPE*

## Epichem Website New Look

The Epichem website has been amended based on customer feedback to incorporate more information and make navigation easier. Particular attention has been paid to the product data and the familiar periodic table introduction screen extended to cover all areas. It is hoped that the upgraded functionality will make finding exactly what is needed more straightforward and comments are always welcome to ensure these changes have been successful.



*Revised website offers improved access*

# New Zirconium Oxide Precursor for ALD

*Molecular design using chemical expertise has successfully produced an improved performance precursor*

As the size of memory devices continues to be reduced the traditional materials used for the dielectric layer are becoming unsuitable.  $\text{Al}_2\text{O}_3$ , grown by atomic layer deposition (ALD), is already being used commercially to replace  $\text{SiO}_2$  but to meet future demands materials with even higher dielectric constant are required. Hafnium oxide based materials have been investigated for some time and several precursors for ALD are now available to high purity in large volume, including two new sources designed by Epichem to provide optimum performance.

For the next generation of memory devices there has been renewed interest in zirconium oxide based dielectric layers and particular attention to deposition via ALD. Epichem has therefore designed a new zirconium precursor specifically for ALD based on its highly successful  $\text{HfO}_2$  ALD work. Figure 1 illustrates the structure of the new source ZrD-04, Bis(methylcyclopentadienyl)methoxymethylzirconium(IV). The physical properties of this source (high thermal stability, excellent reactivity, liquid) are such that it offers significant advantages over conventional zirconium sources ie Zr amides.

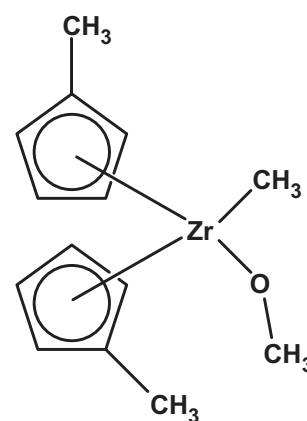


Figure 1 ZrD-04 structure

In detail the ZrD-04 shows good vaporisation characteristics and low residues in thermogravimetric analysis (TGA) and its vapour pressure is such that bubbling or direct liquid injection precursor delivery methods are equally suited. Figures 2 and 3 highlight the beneficial physical properties of ZrD-04 by comparison with the current precursor of choice  $\text{Zr}(\text{NEtMe})_4$ .

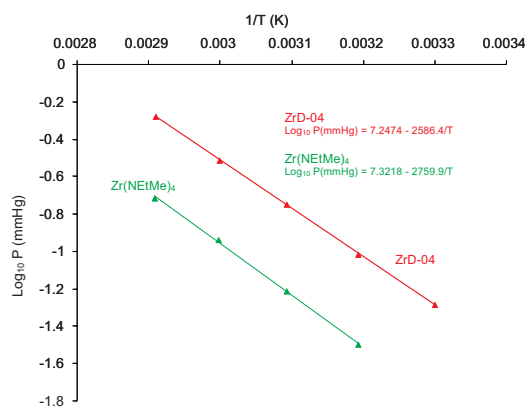


Figure 2 Vapour pressure data for ZrD-04 and TEMAZ recorded by Epichem

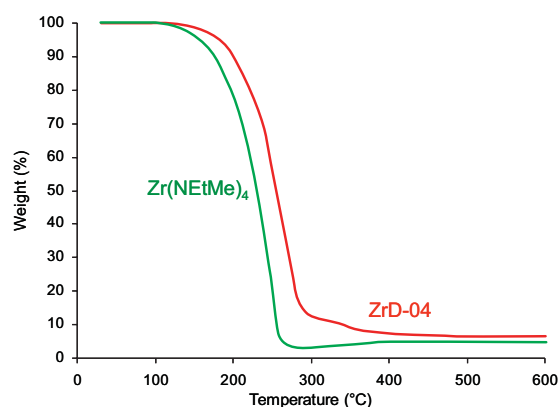


Figure 3 TGA data for ZrD-04 and  $\text{Zr}(\text{NEtMe})_4$

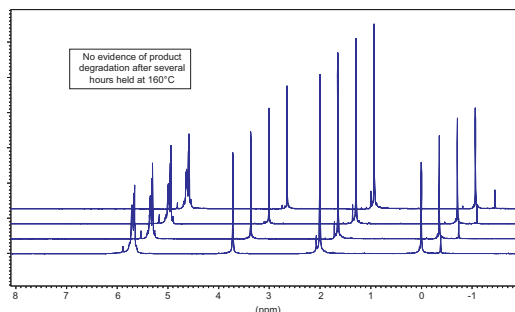


Figure 4 ZrD-04 at 160°C NMR stability data after 0hr, 1hr, 3hr and 6hr

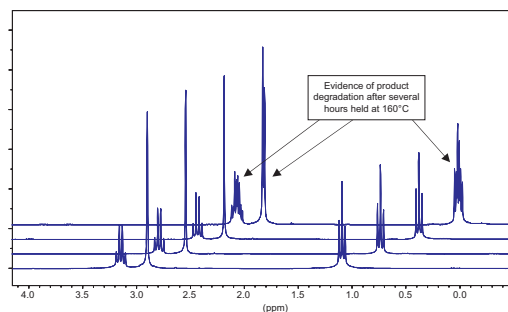


Figure 5 Zr(NEtMe)<sub>4</sub> at 160°C NMR stability data after 0hr, 1hr, 3hr and 6hr

The long term stability of the source was also examined and compared to a conventional Zr amide source. Figures 4 and 5 highlight the differences observed when holding samples at 160°C for prolonged periods. A total absence of any decomposition in the ZrD-04 case contrasted with degradation of the conventional amide source after 6 hours. The ZrD-04 source can therefore be operated at higher temperatures without transport variation over time.

Another particular advantage attributable to the increased thermal stability of ZrD-04 is access to higher deposition regimes that should make process integration easier. To assess the true benefits of the source a series of ALD growth studies have been performed at a number of test sites with remarkable results to demonstrate 'true' self limiting ALD at a deposition temperatures of 300°C. Deposition at even higher temperatures is also reasonably controllable thus the deposition growth window has been enlarged to give a highly robust process that is not as temperature dependent as current ZrO<sub>2</sub> ALD processes.

The data recorded using ZrD-04 and H<sub>2</sub>O with a source temperature of 68°C and reactor pressure of 2-3 mbar is shown in Figures 6 and 7. Evidence for thermal decomposition of the source is not observed until 375°C with temperatures over 400°C necessary to move fully to the kinetic regime of the growth curve.

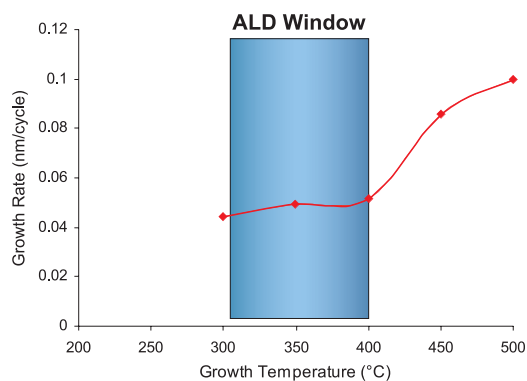


Figure 6 ZrD-04/H<sub>2</sub>O growth rate vs temperature data

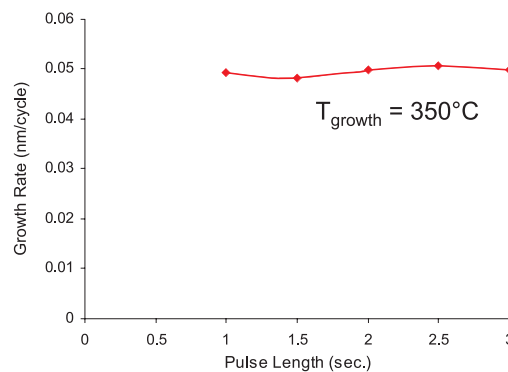


Figure 7 ZrD-04/H<sub>2</sub>O growth rate vs pulse length data

*New source offers true self-limiting ALD over wider temperature range*

# REACH - a New Chemicals Policy for the EU and Beyond

*Epichem shipping keeps on top of changing regulations to facilitate product shipments around the globe*



## Registration, Evaluation & Authorisation of Chemicals

Today's modern society needs chemicals, and the EU chemicals industry is an important sector for the EU's economy. However, we know very little about our chemicals and in the majority of cases we do not have enough information about effects, uses and safe handling protocols and so the production and wide-spread use of such substances may pose risks to human health and the environment. The new EU chemicals policy, REACH, requires producers and importers of all chemicals to register them along with the information needed to use them safely.



In 1981 the one and only listing of chemicals used in Europe had over 100,000 entries but over 99% did not have fully comprehensive information on the chemicals' properties and safe usage parameters. REACH aims to rectify this situation leading to compliance with the global commitment agreed at the 2002 World Summit on Sustainable Development in Johannesburg 'to achieve, by 2020, that chemicals are used and produced in ways that lead to a minimisation of significant adverse effects on human health and the environment'.

The methodology employed involves the generation and dissemination of information on chemicals, in particular safety information, and Epichem is implementing a series of studies to allow the compilation and distribution of comprehensive data on all its chemicals. Traditionally Epichem has a strong health, safety and environmental impact policy that is reflected in its receipt of ISO14000 certification along with 10 consecutive years of the British Safety Council Safety Award. Building on this sound base using experimental and chemical expertise will ensure the above task is completed in a timely fashion to meet all regulatory requirements.

For further details on REACH visit [http://ec.europa.eu/environment/chemicals/reach/reach\\_intro.htm](http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm)

## Changes to UN Numbers

One area that undergoes constant scrutiny is the shipping of hazardous goods and great care must be taken to assemble the physical properties of chemicals to allow correct assignment of product categories. The Epichem shipping department monitors changes in legislation and passes the relevant information to all customers to ensure compliance. To highlight this point the following changes to UN classification numbers for several of our products have been made in the last months and all future referrals must use the new data. Whilst this information is provided directly to the customers using these products please check that the following information is correctly recorded by your safety / shipping personnel.

### Changes to product UN numbers from 1st Jan 07:

Old UN no.	Chemical name	New UN no.
UN 2445	Tertiary butyl lithium	UN 3393
UN 2445	N-butyl lithium	UN 3393
UN 3076	Dimethyl aluminium hydride	UN 3394
UN 1366	Diethylzinc	UN 3394
UN 1370	Dimethylzinc	UN 3394
UN 3051	Tertiarybutyl aluminium	UN 3394
UN 3051	Trimethylaluminium	UN 3394
UN 3051	Triethylaluminium	UN 3394
UN 3051	Diethyl aluminium ethoxide	UN 3394

# Torque Settings for BCl<sub>3</sub> Drum Valves

Epichem has been successful in selling its BCl<sub>3</sub> in tonne drums (975 kg) in recent years. This package has proven convenient and robust in the supply of large amounts of liquid (or gaseous) BCl<sub>3</sub> into customers' processes. The valve that we use has likewise proved to be reliable however it must be operated within certain basic guidelines. The valve hand wheel in this case is a large square nut. As with many valves there is a recommended torque to close the valve (10 Nm) and a maximum torque to be applied to this valve (25 Nm). Using the recommended torque to close the valve will ensure that it can be repeatedly and safely closed for the life time of the valve (up to 5 years). Torques in excess of this recommended value will reduce the life time of the valve. Torques above 25 Nm may result in the valve being damaged.



*Safety update for gas container valves to ensure best practice is maintained*

Epichem has recently experienced the damage of such a valve by, we believe, over torquing. The best way to apply torques to any valve is via a calibrated torque wrench or similar device, this removes the guess work and variation of being "hand tight".

If you have any questions on BCl<sub>3</sub> or the vessels that it is supplied in please contact Epichem.

## Valve Connections for Silane

The safe use of chemicals applies to all areas and the first point of call is the connection of the supplied container to the customer system. In the case of silane, a highly hazardous, pyrophoric gas, strict protocols must be followed to ensure high integrity connections are made and no product can escape. Any error can lead to the formation of an inflammable gas cloud that requires no external ignition source.

Silane is usually sold in ~50 litre cylinders (single cylinders or in manifolded bundles of cylinders) fitted with a high quality valve. These valves can be of various types - manually operated or pneumatically actuated; made of brass or chrome plated brass or stainless steel, etc. Furthermore there are a number of different valve outlet connections that can be and are being used for silane. The most common of these are DIN 1, CGA 350, AFNOR E and DISS 632. These valve outlets are all different and whilst each one can provide a good repeatable seal using different techniques (see the diagrams below), it is critical that they are ONLY used with the corresponding connection on the use-point. For example a DIN 1 cylinder valve must only be connected to a DIN 1 connection on the use-point (sometimes called a "pigtail"). Mixing a DIN 1 or any other valve outlet with a different connection type can lead to leaks and/or damage to the valve outlet and the user's connection point.

Users of gas should therefore make every effort to ensure that all gas cylinders are correctly identified and only used on appropriate use points. After a cylinder has been connected to a use point the connection should be tested to ensure that it is leak tight and that no gas can escape. In the case of silane this leak test should be carried out to the highest levels.



**AFNOR E**



**CGA 350**



**DIN 1**



**DISS 632**

If you have any questions regarding the use of this hazardous gas please contact Epichem.

# Epichem round the globe



*Epichem is a truly  
global company*

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