epichem group

e-news

29 March 2004

Welcome to our first e-news issue. Epichem invites you to forward this newsletter to colleagues who may be interested in the articles.

IN THIS ISSUE:

Nanodots for Oxygen and Hydrogen Sensors (NOAH)

In November 2001, the NOAH project started with a concerted effort to develop the chemistry needed to produce III-V semiconductor Quantum Dots (QD's) from novel single source precursors. To be useful in gas sensing applications, strict control of the QD properties was defined as a key objective and previously reported results were not sufficiently uniform. However, these data were produced from individual sources for As and Ga where a heavy reliance on 100% reaction efficiency is present to gain tight particle size and property distributions. The single source approach successfully developed for II-VI QD formation was highlighted as a more promising approach to obtain reproducible controlled results.

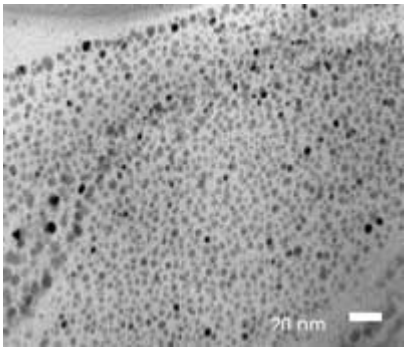


Figure 2 TEM of GaAs QD array showing average size of 3.2nm

On this project, Epichem and Manchester University worked closely together to identify compounds containing direct Ga-As bonds that held high potential and the synthetic approaches required to make such materials. The precursors were isolated to high purity prior to formation of solutions for transformation into QD's following conventional techniques previously used for II-VI QD formation. The thermolysis parameters for these sources and the 'capping agents' and solvents employed contributed greatly to the size and uniformity of the QD's formed. To our knowledge, this is the first time that the GaAs nanoparticles have been prepared from a single source precursor. Manchester University have then applied the QD solutions to substrates and treated them to form arrays for testing using a variety of techniques to assess the potential gas sensing properties. The other partners have assisted the research and will take the simple test structures forward through mounting and packagi! ng to the final useable prototypes. With a year to run this last phase, it will be of key importance to the success of the project.

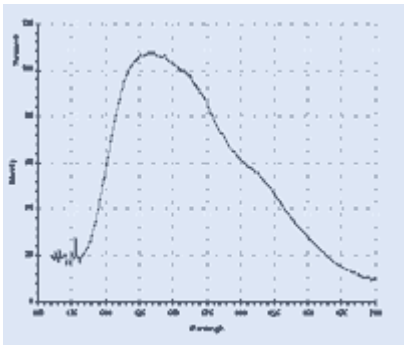


Figure 3 PL spectrum (30K) for thin film of GaAs dots

In more detail, the single source precursor identified and prepared to high purity was [tBu2AsGaMe2] (see Figure 1). QD formation by thermal treatment of a solution containing this compound, hydrocarbon and a coordinating ligand was investigated using numerous combinations of chemicals and conditions with the effect on properties noted. Using hexadecylamine as both solvent and additive and its subsequent removal by heat treatment, an array of QD as shown in Figure 2 and 3 can be achieved in reproducible fashion.

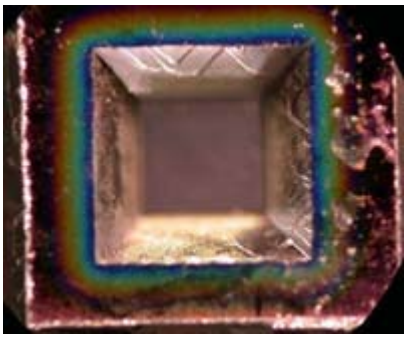


Figure 4 Silicon micro hotplate prior to III-V QD application.

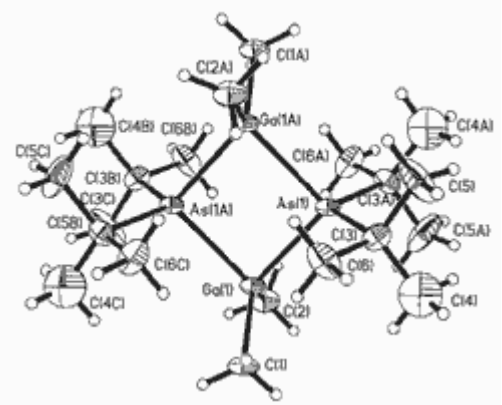


Figure 1 Crystal structure of [tBu2AsGaMe2]

Having obtained procedures to deposit QD films, their application to a micro hot plate (see Figure 4) and subsequent inclusion in a device (see Figure 5) for testing for gas sensing properties was performed. Whilst still at an early stage it is thought that devices based on this technology will achieve performance levels suitable for useful gas sensor products to be demonstrated and commercialised.

For further details visit the project website http://www.cs.man.ac.uk/~mtoohey/index.htm

All project partners gratefully acknowledge the support received from UK government
Partners: Epichem, Manchester University, Alphasense, Teer Coatings, Quality Sensor Systems, Stakesolve

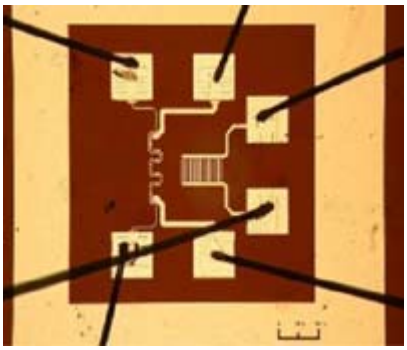


Figure 5 Sensor device showing electrodes and resistance thermometer, with bond wires

President Bush Presents the Laureates of the 2002 National Medals of Science and Technology

The National Medals of Science and Technology honor individuals in a variety of fields for pioneering scientific research that has led to a better understanding of the world around us, as well as innovations and technologies that provide global economic benefits. Their groundbreaking contributions commercialize technologies, create jobs, improve productivity and stimulate the nation's growth and development. The National Science Foundation administers the Science award, established by Congress in 1959, with the Department of Commerce dealing with the Technology award, established by Congress in 1980. For more information about the National Medal of Science and the National Medal of Technology visit www.nsf.gov/nsb/awards/nms/medal.htm and www.technology.gov/medal.

When President George W. Bush announced the recipients of the nation's highest honor for science and technology, Epichem were pleased to find a long term collaborator in the list of laureates. Prof Russell D. Dupuis received the National Medal of Technology at a White House ceremony on November 6, 2003 in recognition of his outstanding contribution to semiconductor technology development. Epichem wishes to add its congratulations to Russ and his fellow medal recipients.

NMT team with President Bush: left to right Russell D Dupuis, M George Craford, Nicholas Holonyak, Jr, President GW Bush

Barry (left) and Russ with his National Medal of Technology

A new face in the Epichem sales team

Epichem are please to introduce the newest member of its global sales team, Aimee Wright. Aimee graduated from Oklahoma State University with a Bachelors of Science in Chemistry before returning to her hometown to work for EaglePicher Technologies, LLC. Employed as Technical Sales Manager, Aimee was responsible for the supply of CVD and Ion Implant precursors and delivery equipment to the semiconductor industry. Later she became involved in EaglePicher's efforts to provide ultra-clean and treated containers to both the semiconductor and pharmaceuticals industries.

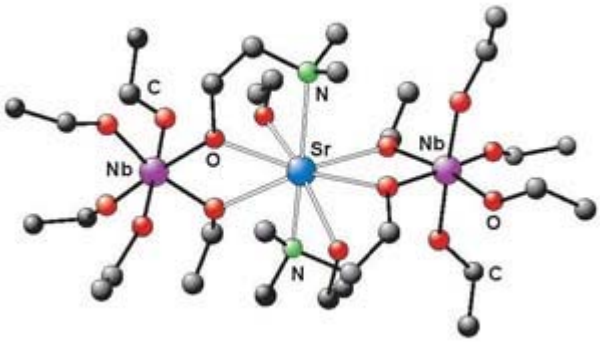
Aimee has recently relocated to Northern California to hold the position of west coast sales manager at Epichem. She states "Today I am happy to be a part of Epichem's sales team. I am excited about the opportunities and future of Epichem and am encouraged by our forward-thinking outlook".

MRS Fall Meeting Review

The 2003 MRS Fall Meeting was held in Boston, MA from November 30 to December 5, 2003. It included six days of scientific and technical talks, poster sessions, the award ceremony, plenary session, tutorials, special events, exhibit, and other activities. Overall, the meeting was well attended and a complete success, with a record 4,800+ attendees and over 4,200 papers presented in oral and poster sessions.

The Epichem Group presented two oral papers at the MRS fall meeting. The first in symposium C (ferroelectric thin films), an invited talk titled "Liquid Injection MOCVD and ALD Studies of 'Single Source' Sr-Nb and Sr-Ta precursors". The second, in symposium E (fundamentals of novel oxide/semi-conductor interfaces) titled "Liquid Injection MOCVD of Rare-Earth Oxides using New Alkoxide Precursors".

The invited paper presented in session C4 focused on a range of 'single source' strontium-niobate and strontium-tantalate heterometal alkoxide precursors as potential sources for liquid injection MOCVD (metalorganic chemical vapour deposition) and ALD (atomic layer deposition) of $SrBi_2Ta_2O_9$ (SBT) and $SrBi_2(Ta_xNb_{1-x})_2O_9$ (SBTN) thin films. Ferroelectric thin films are used in ferroelelectric capacitors for non-volatile ferroelectric random access memory (NV-FERAM) and dynamic random access memory (DRAM). The 'single source' precursors presented are designed to alleviate the mis-match between the typical strontium, tantalum, niobium and bismuth sources currently used in MOCVD. Strontium-tantalate and strontium-niobate thin films were deposited on silicon usi! ng the 'single source' alkoxide precursors $[Sr\{Ta(OEt)_5(dmae)_2]$ and $[Sr\{Nb(OEt)_5(dmae)\}_2]$ (dmae = $OCH_2CH_2NMe_2$) (see figure), and the optimum temperatures for deposition of stoichiometric $SrTa_2O_6$ and $SrNb_2O_6$ were determined. Separate ALD studies of $[Sr\{Ta(OEt)_5(dmae)\}_2]$ and $[Sr\{Ta(OEt)_5(mee)\}_2]$ (mee = OCH_2CH_2OMe) for the growth of strontium-tantalate were carried out to assess precursor suitability for this technique. Liquid injection MOCVD of Bi-oxide films using $[Bi(mmp)_3]$ (mmp ! = $OCMe_2CH_2OMe$) indicates similar decomposition behaviour to the Sr-Ta and Sr-Nb alkoxides, demonstrating its suitability as a complementary source of Bi for SBT, SBN and SBTN.



SrNb stabilised double alkoxide structure

The paper presented in the joint session C9/E9 (gate dielectrics and functional oxides on silicon) dealt with the MOCVD of rare-earth oxide thin films from new alkoxide precursors. MOCVD of rare-earth oxides such as La_2O_3, Pr_2O_3, Gd_2O_3 and Nd_2O_3 have potential applications as alternative high-κ gate dielectric layers in silicon-based field effect transistors. The work presented focused on the deposition of high purity lanthanum oxide and praseodymium oxide thin films (C< 1 at.-%) using the volatile alkoxide precursors $[La(mmp)_3]$ and $[Pr(mmp)_3]$ in toluene-solutions. Additional solution studies demonstrated that the addition of donor species to the precursor solution, such as tetraglyme ($CH3O(CH_2CH_2O)_4CH_3$) or mmpH, prevent molecular aggregation and help stabilise the precursors.

Both presentations were well attended, despite being held first thing in the morning, with considerable interest shown in the new precursors presented. Other papers presented during the session highlighted the importance of finding an alternative high-κ gate dielectric making the rare-earth oxide work particularly topical. Both of the papers presented are to be published as part of the conference proceedings or can be obtained from Epichem Group.

Full details of Epichem research topics can be found at

http://www.epichem.com/epichem_group/research_devel/current_projects.html

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