Volume 16, Issue 1 Spring 2006

Vibrations

Ultrasonic Industry Association

Sun Shines on the 2006 Symposium in San Diego

Industrial Session participants listen attentively.

More than 60 ultrasound professionals attended the two day symposium on Coronado Island facing San Diego Bay on 13 - 14 March.

The symposium began with the presentation by Bajram Zeqiri, Acoustics Team, Quality of Life Division, National Physical Laboratory, United Kingdom, on *A reference vessel for acoustic cavitation: initial characterization of the spatial distribution of cavitation activity derived using an acoustic emission sensor* as the guest speaker for the industrial sessions on Monday. Late Monday afternoon the HIFU Council met (see story on page 7).

Tuesday's session on Medical applications began with an invited paper on *A Methodology for Ultrasound Product Development – Applications in HIFU and High Frequency*, by Claudio Zanelli CEO, Onda Corporation.

The afternoon sessions began with an invited paper on *Overview of 3D/4D Ultrasound*, by Thomas R. Nelson Division of Physics & Engineering, Department of Radiology, UCSD.

Session chairs for this symposium were Karl Graff, EWI - Industrial Sessions and Ron Manna, Misonix and Alan Winder, J&W Medical, LLC, co-chairs, Medical sessions.

New this year was the distribution of all of the presentations on a 256 mb flash pen. This enabled each participant to receive all of the papers, including those that were not provided to UIA prior to the beginning of the symposium. A limited number of pens loaded with the Symposium papers, abstracts and UIA membership directory are available to UIA members at $95 each. Please contact UIA to order.

Congratulations to:

- N. Marandian Hagh, winner of the 2006 Graduate Research Paper Award
- Kevin Houser, P.E, Endo-Ethicon Surgery, winner of the Best New Ultrasound Product for 2005

2007 Symposium to be held at NPL in England

The UIA Board of Directors accepted an invitation from the National Physical Laboratory (NPL) in Middlesex, England, to hold the 2007 Symposium 19 - 21 March 2007.

Highlights of this symposium will include a tour of NPL, which is the NIST for the UK. Other plans for this symposium include poster sessions as well as exhibits by ultrasonic companies from both US and Europe.

Bajram Zeqiri and Mark Hodnett, Acoustics Team, Quality of Life Division, NPL, are working with Margaret Lucas, University of Glasgow, to identify invited speakers from Europe. Ron Manna, Misonix, is serving as the chair of the symposium and is working with Alan Winder, Robert Muratore, Karl Graff and others to identify invited speakers from US.

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Inside this issue:

President's Message

Foster Stulen, 2007 UIA President

Greetings from your 2006 President, Foster Stulen. Of course, it is on honor to be elected to this position, especially given the stature and reputation in ultrasound of our past presidents. In addition, I am extremely fortunate to hold the position in a very exciting period in UIA's history.

The recent 35th Symposium held at San Diego was a success in every way. The presentations were great, the venue and service of the hotel were impressive, and it was a financial success. Many thanks to our Symposium Chairpersons Alan Winder and Ron Manna.

We, as an organization, are breaking new ground next year by holding our first international symposium. The 36th Symposium in 2007 will be held in England at the world-renowned National Physical Laboratory, 19 - 21 March. So please plan to attend and considering giving a paper (see page 7).

Take advantage of this opportunity to hear of the work being done in Europe and network with your international peers. Also please promote the symposium with your colleagues.

It is with sadness that I acknowledge Tom Kirkland's departure from the Board and from the field of ultrasound. He has always been a strong advocate and selfless volunteer for the UIA. But it is my pleasure to welcome our new first-time Board members: **Leo Klinstein** of Dukane, **Robert Griswold** of Branson, **Jack Sliwa** of St. Jude Medical and **Robert Muratore** of Riverside Research Institute.

I would like to express the Board's appreciation to Fran Rickenbach of MEI and our Executive Director. Fran is working closely with board to ensure the success of UIA events and to promote our image.

The Future Starts Now by Tom Kirkland, UIA President 2006

"UIA is seeking to increase our relevance on an international basis."

I suppose the title of this letter could be construed to be a rewording of the old, "today is the first day of the rest of your life" cliché, but as I considered what to say in my last opportunity to address the membership of the UIA as a whole, I wanted to do the opposite of engaging in a teary retrospective. While the history of the UIA is indeed remarkable and I am proud of my small part in it, I believe it would be a disservice to the Association to have my last message be any more about the past than any of the others.

So what is the direction of the UIA right now? We are obviously moving forward on two fronts.

First, we are seeking to increase our relevance to the medical device industry. The board believes that this is an area with the potential to produce breakthroughs in the art and science of high power high frequency acoustics, much as metal and plastic welding and materials processing did a decade or two ago. While there will continue to be much innovation in industrial uses of high power ultrasound, the fastest-moving and best-funded research is in the medical field at this time and for the foreseeable future. If you dispute this point, then we need your voice on the board.

Second, we are seeking to increase our relevance on an international basis. To limit ourselves to a single country or a single continent is to limit our ability to grow (in both size and relevance) to the growth potential of the markets of our current member base. We think UIA has a bigger mission and a bigger vision than that.

In the past few years, I have seen presentations at UIA symposia that would have absolutely blown the minds of anyone in our industry just a decade ago. A great many of those presentations have come from outside the U.S. and outside of our traditional constituency. It makes sense that if we are to thrive in the future, we go where the action is. I have been a plastic welder guy for most of my career, and it is my fervent hope that UIA would never become irrelevant to our traditional constituency, however, our mission requires us to change as our industry changes and grow as it grows.

Indulging my need to reminisce for just a second, I recall first attending a UIA symposium over ten years ago, and I have been on the board for eight years. The experience has greatly enhanced my understanding of the technology and the industry. I have most enjoyed closely working with quality people I would not have met otherwise. In total it is one of the richest experiences I have ever had. It is my hope that as I leave the UIA board, it is better than it was before I arrived. The future will tell.

Graduate Research Paper Award Winner

Lead-Free Piezoelectric Ceramic in the K1/2Na1/2NbO3-Solid Solution System by N. Marandian Hagh, E. Ashbahian, and A. Safari, Department of Ceramic and Materials Engineering, Rutgers, The State University of New Jersey

Abstract: Lead-based piezoelectric ceramics are only available materials for non-invasive medical ultrasound applications, while the embedded therapeutic and diagnostic procedures require lead-free piezoelectric transducer material. In order to achieve that, ultrasound material technology needs to be extended so as to be applicable for invasive ultrasonic applications.

Along this goal, perovskite-type piezoelectric system of (K1/2Na1/2NbO3-LiTaO3-LiSbO3; KNN-LTLS) has been investigated. The effect of Ba2+ ion as an A-site additive has shown the improvement on the permittivity, piezoelectric charge coefficient as well as planar and longitudinal coupling coefficients. Piezoelectric charge coefficient, *d33*, and longitudinal coupling coefficient, *k33*, were shown up to 36% and 58% improvement upon 1 mol. % Ba2+ substitution. Remnant polarization increment along with coercive field decline was observed when 1 mol. % Ba2+ is introduced. This characteristic along with piezoelectric property improvement is indicating the soft piezoelectric behavior in this system. Microstructure studies have shown that substitution of 1 mol. %Ba2+ has lowered the grain size while improved the densification behavior of samples.

Foster Stulen, UIA President, presents 2006 Graduate Paper award to N. Marandian Hagh

To demonstrate the performance capability of the base composition, a single element ultrasonic transducer was fabricated and the pulse-echo characteristics measured. At a center frequency of 3.56 MHz, the transducer had a -6 dB fractional bandwidth of 36.8% and an insertion loss of – 8.36 dB. The studied lead-free piezoceramic system could be an excellent candidate for invasive and/or embedded medical ultrasound applications.

2005 Best New Ultrasound Product

Harmonic Ace, a new product developed by Ethicon Endo-Surgery, a Johnson & Johnson Company, is the winner of the UIA Best New Ultrasound Product for 2005.

The top three customer needs for Harmonic were identified and addressed in this new product:

- Hemostasis of Larger Vessels
- Faster Transection
- Reduced Technique Sensitivity

Significant development work was completed to develop design variables leading to larger vessel hemostasis. The final analysis indicated that an increase in clamp pressure was the major enabling variable. The same variable that enabled larger vessels also played a major role in transection speed. Higher clamp pressure allows for faster transections, even with lower amplitude. By providing improved hemostasis, the need to "feather" is reduced. Increased transaction speed reduces the need to "speed up" transactions. A higher clamp force makes ACE a better grasper. The click design allows for a reduced learning curve.

Kevin Houser, P.E. Ethicon Endo-Surgery, left, receives his award from Ron Staut, UIA Treasurer

Assessing the spatial distribution of cavitation activity in ultrasonic cleaning vessels using acoustic and erosion methods

Mark Hodnett and Bajram Zeqiri, NPL, Teddington, UK

Acoustic cavitation, defined as the growth, oscillation and collapse of microbubbles within a fluid driven by a sound field plays a key role in ultrasonic cleaning and other processes. High power ultrasonic systems such as cleaning vessels are complex acoustic environments as, at the frequencies of general interest (20 – 200 kHz), the sound fields generated are strongly reverberant, and the development of cavitating bubbles will scatter and absorb the applied sound. Also, the high powers applied result in heating and degassing of the liquid, such that the cavitation produced in the vessel is strongly time-dependent.

Consequently, there has been a long-standing requirement to develop real-time measurement methods for quantifying acoustic cavitation. This is particularly important for safety related applications, such as the cleaning of surgical instruments, where it is vital to ensure that the vessel cleans effectively throughout its volume. However, although a range of techniques have been investigated, none has been found suitable for standardisation, and the best qualitative way of assessing cavitation in a cleaning vessel remains the use of thin aluminium foils, which can record the occurrence of cavitation through erosion and surface indentations.

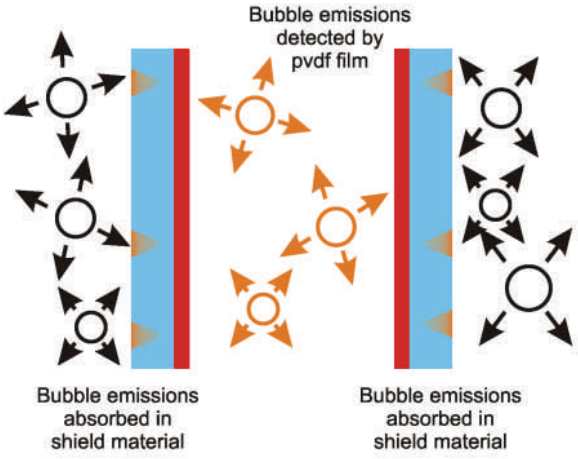
A comparison has been carried out between foil erosion and measurements made using a sensor developed specifically for measuring the spatial variation of cavitation activity in high power ultrasonic systems. It operates by monitoring the high frequency (> 1 MHz) acoustic signals present in the 'white noise' spectrum that is characteristic of collapsing bubbles.

A photograph of 3 cavitation sensors is shown left. The sensors are open-ended hollow right-circular cylinders, whose inner surface is made from a 110 μm thick layer of piezoelectric material, polyvinylidene fluoride (*pvdf*). In use, the sensor is immersed vertically in the liquid medium which then fills the hollow cylinder.

The *pvdf* layer senses acoustic signals generated by cavitation occurring within the volume enclosed by the cylinder. The *pvdf layer* is bonded to a 4 mm thick polyurethane-based rubber material which forms a rigid outer coating for the sensor and which is highly attenuating at *MHz* acoustic frequencies. It therefore acts as a 'cavitation barrier', shielding the inner *pvdf* film from acoustic signals originating from cavitation throughout the remainder of the system under test.

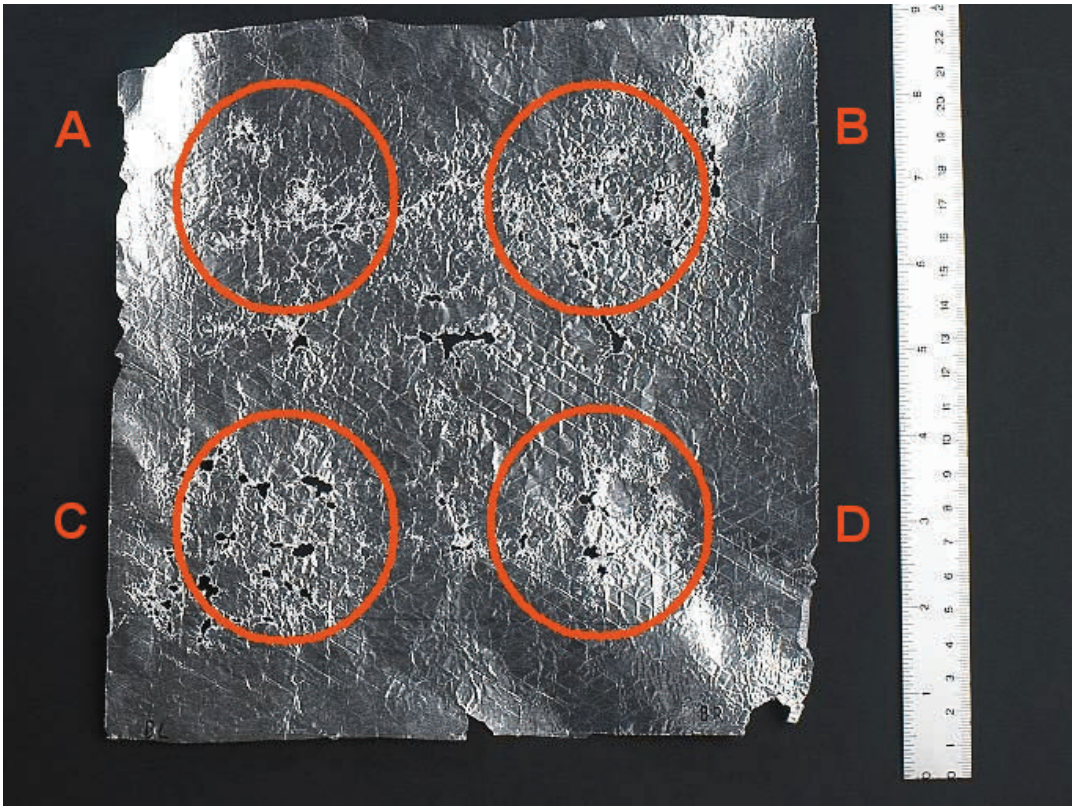
The sensor is connected to a prototype filter-amplifier, which is designed to measure signals over the range 1 MHz to 7 MHz. The unit provides a visual display of the *rms* signal level over this frequency band and for the comparison study, was connected to an outboard *rms* voltmeter, allowing cavitation sensor signals to be acquired under PC control. The ultrasonic cleaner used for the study was a 40 kHz system, with 4 transducers bonded to the vessel base. It was run at an operating power of 140 W (determined using a power analyser). Its dimensions were 330 mm x 300 mm x 130 mm (depth). For all measurements, the vessel was filled to the manufacturers operating specification which required 7 litres of water, to an average depth of 80 ± 2 mm.

Erosion assessments were carried out using Bacofoil Release Non-Stick Foil (Bacofoil consumer products), which was typically 0.001 inches thick. The foil was positioned in the vessel using a frame made from 2 mm diameter wire. Gas content strongly impacts on both cavitation and cleaning behaviour, so much so that without gas, it is well established that little or no cleaning is produced. So, measurements were made in deionised-filtered water that was initially saturated in terms of its gas content. The use of this as a well-defined and repeatable medium for testing, rather than tap-water which is used industrially, was due to the greater reproducibility in the water temperature, which was typically 20 ± 2 °C. In keeping with typical practice, a surfactant recommended by the manufacturer was added, at a concentration of 1%.

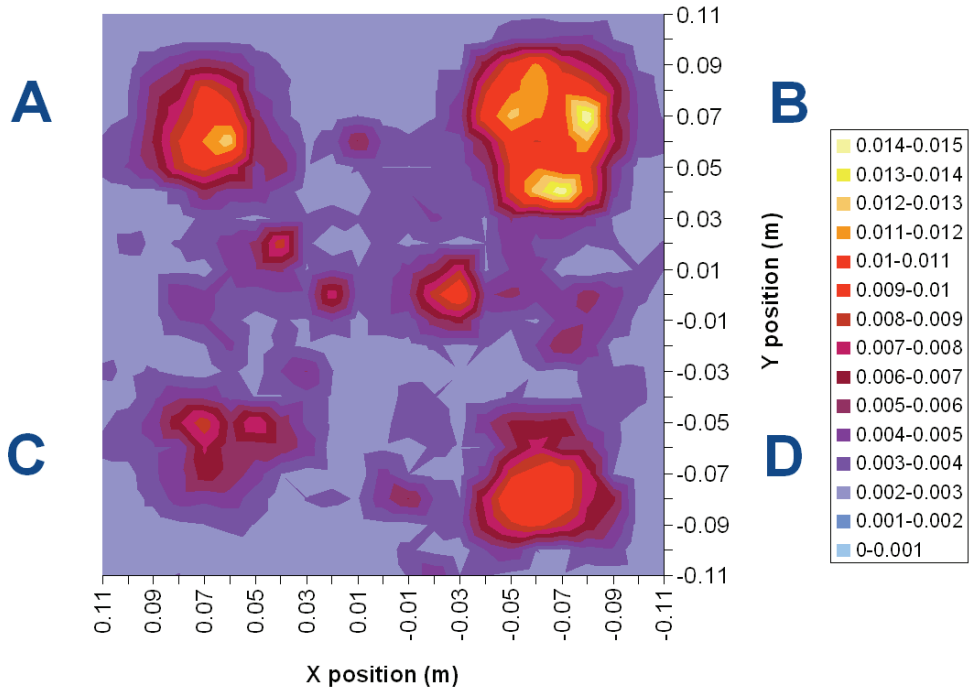


The photograph shows the erosion patterns produced by the whole cleaning vessel when using a horizontally mounted piece of Bacofoil (of dimensions 210 mm by 210 mm) designed to cover all four transducers.

The foil was positioned at a distance of 9 mm below the water surface, and left for 30 seconds. The approximate positioning of the four transducers is identified, and these clearly coincide with areas of greater erosion.



Assessing the spatial distribution of cavitation activity in ultrasonic cleaning vessels using acoustic and erosion methods, *continued*



The colour map plot shows a 2-dimensional cavitation sensor scan of the entire vessel, with data acquired in a square grid at a resolution of 10 mms. The structure of the four transducers is clearly seen, with transducer B generating the strongest cavitation activity, and transducer C the lowest.

Comparing the two techniques shows a good correlation between the spatial variation of cavitation determined using the new sensor, and erosion tests carried out using thin aluminium foils. It suggests that the sensor can be used as a replacement for the purely qualitative aluminium foil method, as an objective means of determining the spatial distribution of cavitation activity within a medium. Current studies are examining the performance of the sensor and electronics in a range of industrial environments.

Bajram Zeqiri and Mark Hodnett, are on the Acoustics Team, Quality of Life Division, National Physical Laboratory, Middlesex, England, UK. This paper was presented at the 2006 UIA Symposium in San Diego, California

More Information about the UIA 2007 Symposium

Important Dates

Call for Papers available at www.ultrasonics.org	31 May
Deadline for Abstracts	31 August
Hotel information available	15 June
Final Program Schedule available	15 November
Early registration deadline	26 January 2007
2007 Symposium	**19 - 21 March 2007**

National Physical Laboratory, Middlesex, England, site of UIA 2007 Symposium

Updated information will be posted regularly at www.ultrasonics.org.

NPL is the United Kingdom's national standards laboratory, an internationally respected and independent centre of excellence for R&D, and knowledge transfer in measurement and materials science.

HIFU Industry Council

At the meeting of the HIFU Industry Council at the 2006 UIA symposium, Mark Schafer agreed to serve as chairman for the next six months. Robert Muratore, Ph.D., Member of the Research Staff, Frederic L. Lizzi Center for Biomedical Engineering, Riverside Research Institute, will then become chairman.

UIA has a mailing list of individuals interested in participating in the HIFU Council. Additional participants may be added to this list by e-mailing their request to uia@ultrasonics.org

Information that was distributed to members at this meeting is now available at http://www.ultrasonics.org/HIFU.html

Mark Schafer is attending the IEC TC87 meeting in mid-May in New Orleans. After his participation in relevant working group meetings Mark will post information to the HIFU mailing list.

There will be a summary of these meetings in the next issue of *Vibrations*.

UIA Board of Directors

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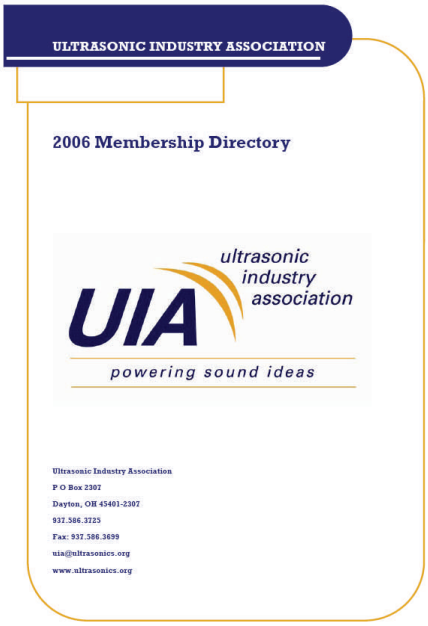
To be a forum for users, manufacturers, researchers and investors in ultrasonic technology

Mission

Improve processes, techniques and materials through application of ultrasonic technology

256 mb flash pen loaded with the 2006 Symposium papers, abstracts and 2006 UIA membership director is available to UIA members for only $95. To place your order, please e-mail your request to uia@ultrasonics.org

2006 Membership Directory Now Available



The 2006 Membership Directory is now available in Acrobat format from the UIA website: http://www.ultrasonics.org/Membershipdir/2006%20UIA%20Directory.pdf

New features of this electronic publication includes live links for the sustaining members and contact information for each member and representative.

To make the size of this publication more manageable for download (it is only 288 kb) advertisements from UIA members were not included. The live links will allow individuals to go directly to the Sustaining Members websites for more specific information.

The 2006 Membership Directory was provided to each participant at the 2006 Symposium on their flash memory pen, along with copies of all the presentations and abstracts.

For more information about the Directory, please contact UIA via e-mail at uia@ultrasonics.org or by calling 937.586.3725.