

# Acal BFi supply bespoke photonics solution to Department of Chemistry at Cambridge University

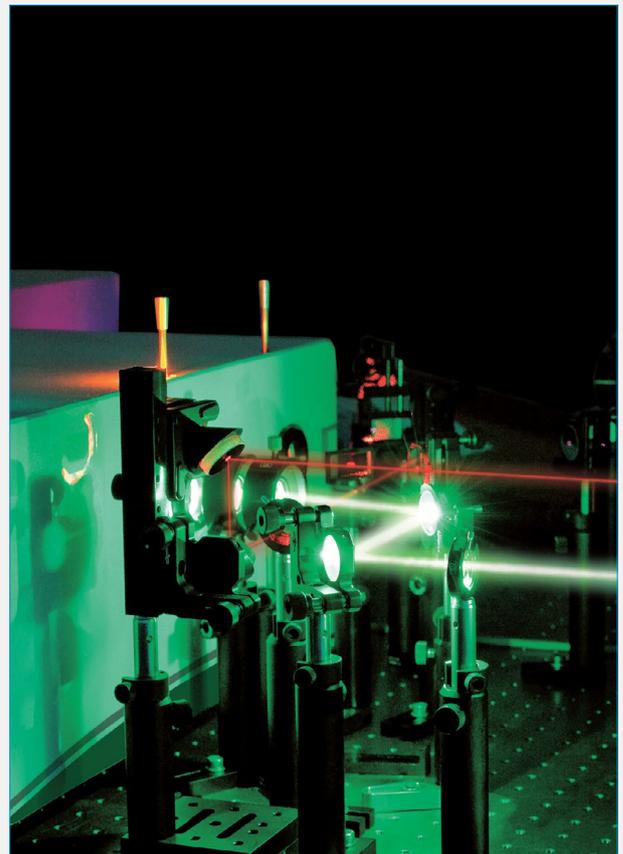
## About the project

The Department of Chemistry at Cambridge University needed a suite of products to aid a significant research project in conjunction with a leading oil company.

The research project centred on the investigation of small friction-modifying molecules adsorbed onto metal surfaces. The investigation of the adsorption of monolayer and sub-monolayer films in a dynamic-wear environment is only possible with sum frequency generation (SFG) spectroscopy. Designed to improve efficient lubrication and extend the life of the oil, the results of this research can be applied to engines from high-performance Formula 1 cars to standard road vehicles – particularly those with diesel engines, where oil performance presents a particular challenge.

In order to test and analyse oil samples with precision, the department needed a sophisticated SFG system, using spectroscopy to analyse the way liquids and surfaces interact. These systems are expensive, representing a significant investment for the department.

It was important, therefore, that the department selected the right system with the right support and advice in place, allowing them to demonstrate value for money, not just for this research project but in the long term.



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## Choosing the Acal BFi-Ekspla

Ekspla are a leading manufacturer of lasers, laser systems and laser components. They supply customers around the world with high-performance products and have a reputation for excellence.

Ekspla chose to work with Acal BFi as their sole UK distributor based on our in-depth knowledge and experience of laser systems, our ability to work closely with customers throughout the tender and sales cycle, and our commitment to after-sales support. We were also able to offer significant commercial advantages, such as public liability insurance.

The team at the Department of Chemistry were aware of the Ekspla products and believed that they would provide the best system for this project. Using the traditional tender process, we were able to show that an Acal BFi-Ekspla approach would offer the following.

- **Technical excellence**

Together we would bring all the required elements together to create a customised package of equipment that met Cambridge's needs exactly.

- **The right people**

We would advise and support, and Ekspla would install and service.

- **Years of experience**

We understand lasers and spectrometry, and how they both enhance chemical analysis. We also have experience in the application and commercial use of these technologies.

- **Support**

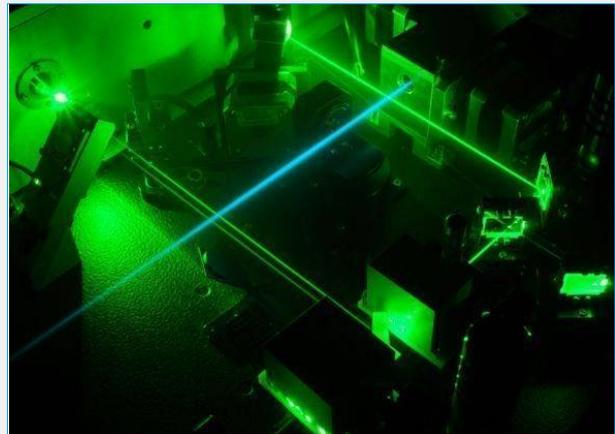
On-time delivery and strong work ethic means we are there when the client needs us. We also provide the first point of contact for questions, replacement parts and resolving issues.

- **Quality**

Cambridge can rely on the quality of all components, products, systems, and expert sales and technical field support.

## The technical solution

Working closely with the team at Cambridge, we were able to specify a range of equipment to meet their needs. The main lasers were supplied by Ekspla, and we were also able to advise on and supply a smaller system for sample testing, delivering a laser with 30% more power than other lasers in its class, alongside fibre coupling and a small spectroscopy unit.



This allowed researchers to obtain initial spectrometry data which helped them to decide whether to run the samples through the more sophisticated equipment.

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## Equipment from Ekspla



**Ekspla:** Picosecond DPSS laser PL2231, and upgrade to PG401-DFG2



**Ocean Optics:** QE65PRO, and fibre-coupled probe for Raman spectroscopy, along with Spectrasuite spectroscopy software



**CNI:** 785nm infrared DPSS 50mW Raman laser



**Ekspla:** Single-channel SFG spectrometer, consisting of a mode-locked Nd:YAG laser PL2251B-20, parametric generator PG401-DFG2, harmonic box H400, single-channel SFG spectrometer, and 6-axis sample holder

With this SFG system, two laser beams mix at a surface and generate an output beam with a frequency equal to the sum of the two input frequencies, producing results specific to the interface.

The advantage of an SFG system is its ability to be monolayer surface sensitive, and for in-situ analysis of samples with minimal damage to the sample surface. This makes it ideal for complex research projects such as this.

This package allowed Cambridge to receive a technically accurate system, which is flexible and adaptable for the main research project, but can also be used in other research in the long term.

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## Results and publications

The team at Cambridge were delighted with the results of the analysis, as the accuracy and reliability of the system allowed the preparation and publication of at least five papers within an eighteen-month time frame. The team also delivered important information to their industrial partner.

"In both the long and short term, the purchase of this machine allows us to expand the frequency range that is accessible to us and has dramatically increased the speed of data acquisition resulting in a marked increase in the number of publications produced each year and also in the number of samples run for our sponsor."

**Dr Mike Casford,**  
*Department of Chemistry, Cambridge University*

Choosing laser systems with a picosecond pulse duration have inherently narrower line width than femtosecond systems. The longer pulse gives increases spectral resolution in comparison to unmodified Femtosecond based systems.

A comparison of spectral resolution from the Cambridge research is shown opposite.

In addition, the team has submitted two academic papers for publication:

***Layer structure of films consisting of activated carboxy terminated monolayers and adsorbed lipid membranes investigated by sum frequency generation spectroscopy***

Mike T.L. Casford, Aimin Ge, Peter Kett, Shen Ye and Paul B. Davies  
Submitted to J Phys Chem B

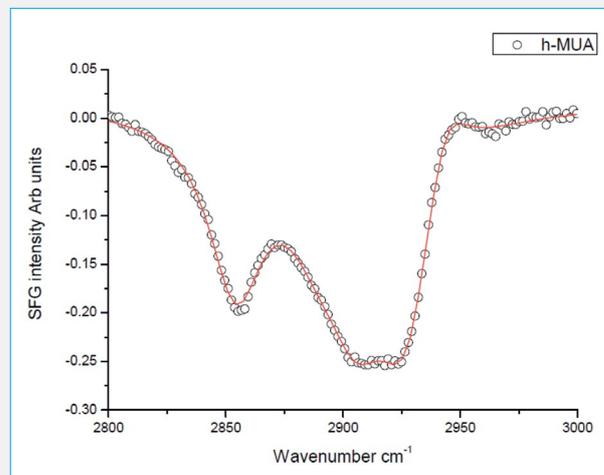
***Hexadecylamine adsorption at the iron oxide-oil interface***

Mary H. Wood, Stuart M. Clarke, M. T. Casford, Ali Zarbakhsh, Rebecca J. L. Welbourn and Timothy Charlton

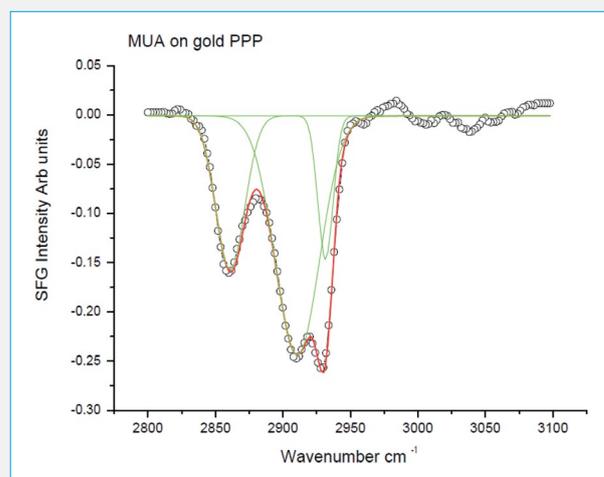
Submitted to Langmuir

## Application results in detail

A comparison of spectral resolution:-



Femtosecond SFG - Two peaks above 2900 cm<sup>-1</sup> are unresolved



EKSPLA Picosecond SFG - Two peaks are clearly resolved at 2910 and 2930 cm<sup>-1</sup> in the picosecond SFG spectrum

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## Positive outcomes for the Department of Chemistry at Cambridge University

Several factors led to the successful completion of this project. Establishing a close working relationship between the Department of Chemistry at Cambridge University, Acal BFi and Ekspla have built trust in the systems we deliver and the advice we give. The Ekspla team went out of their way to support and install the original SFG spectrometer on time for Cambridge, and we maintain good communications with the team so that we can provide replacement or additional systems where necessary.

Acal BFi's wide product knowledge and technical expertise has allowed Cambridge to move forward with an important research project with complete confidence, and our excellent relationship with Ekspla means we can keep our promises and provide clients with the equipment and systems that meet their exact needs.

"The support throughout both the installation and running of the machine has been exceptionally good. The quality of the Ekspla service engineer is outstanding, whilst the support of Clive Morrison from Acal BFi UK has also been of an extremely high standard."

**Dr Mike Casford**  
*Department of Chemistry, Cambridge University*

"Working with Department of Chemistry at Cambridge University has allowed us to demonstrate our capability to understand complex needs and work with our suppliers to ensure those needs are met. Our close relationship with Ekspla has allowed for a smooth process throughout, allowing the team at Cambridge to focus on their research with complete confidence in the equipment we have supplied."

**Duncan Cooper,**  
*Photonics Sales Manager, Acal BFi UK*



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