ISLA project newsletter #5

October 2014

ISLA is a project supported by the European Commission under the Seventh Framework Programme (FP7).

Welcome to the fifth ISLA project newsletter!

Since the last newsletter the project has been granted an extension by the EC, and will now finish in June 2015. This will give the consortium more time to demonstrate the variety of components and lasers that have been developed during the project in a range of industrial applications. We are still looking for potential end users to participate in these trials, so if you would like to be involved, please get in touch (see below)!

In this newsletter we report on:

- *High power testing of 2 µm components at G&H: fused fibre devices and isolators*
- *Fabrication techniques for graphene modelockers by TCD*
- *Progress on rare earth (Tm- and Ho-) doped fibres at ORC Southampton.*

Andrew Robertson (G&H) also runs the 2 µm and mid-IR lasers group on LinkedIn: new members welcome!

Do you have a 2 µm fibre laser application?!

The project is entering its demonstration phase, in which we will be testing the lasers and components on industrially-relevant applications. We already have several tests planned using plastic and solar cell materials. However, we are still on the look-out for new applications from ISLA Advisory Group members or other external organisations. If you have a process which could benefit from ISLA technology, please contact us on one of the emails below, or through the website.

Consortium

Gooch & Housego · Trinity College Dublin (Coláiste na Tríonóide, Baile Átha Cliath) · rofin · University of Southampton Optoelectronics Research Centre · II-VI Laser Enterprise · JDSU · Vivid Components

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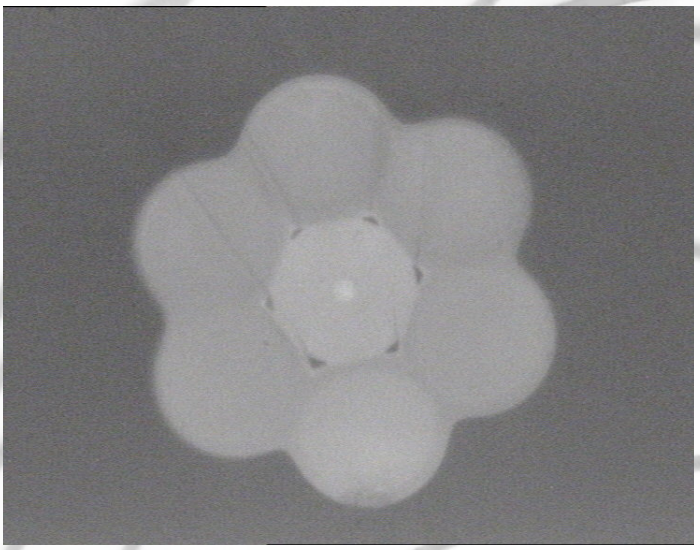
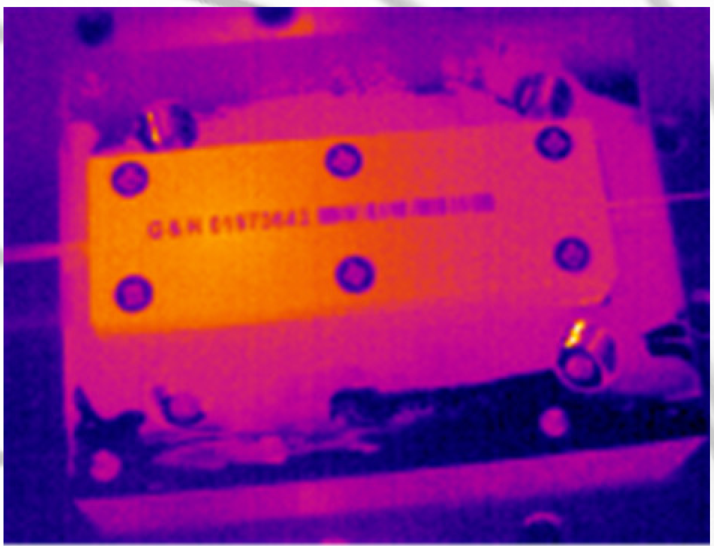
High power testing of 2 µm components

Pump combiners

High power testing at powers >2 kW has been carried out on pump combiners for use in the ISLA demo lasers with excellent results. The pump combiners to be used in the 500 W CW demonstration laser are currently being manufactured and will be tested using new ISLA diodes recently delivered from II-VI Laser Enterprise.

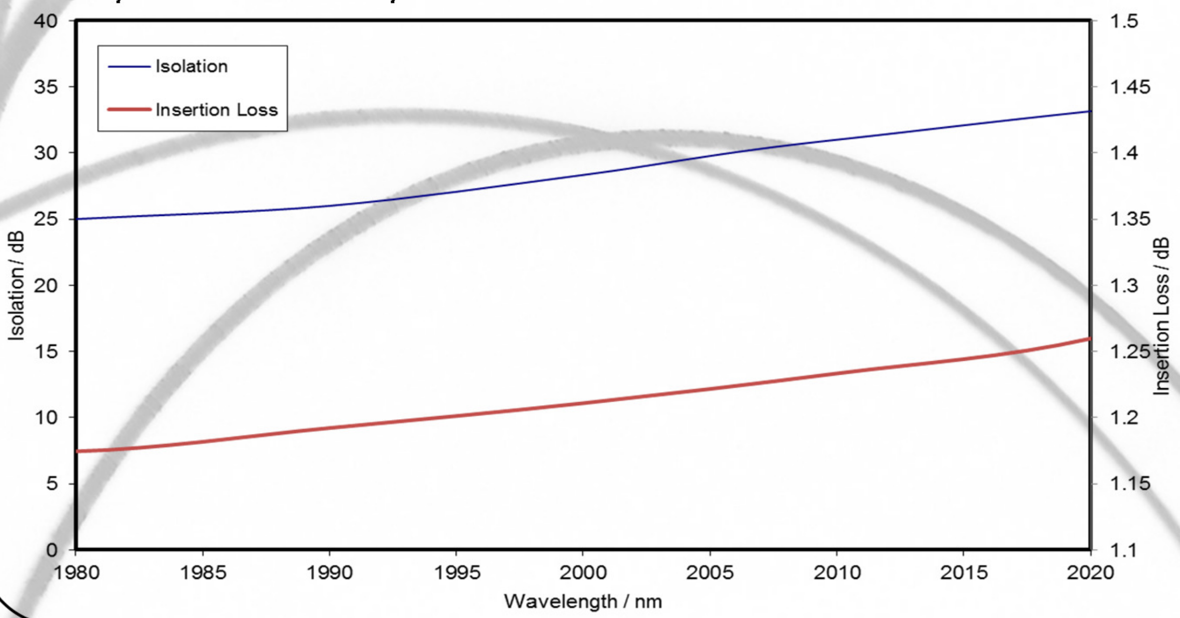




Left: Cross-section of a cleaved high power (6+1)×1 fused fibre combiner
Right: Thermal imaging cameras have been used to map the temperature profile of the packaged combiners.

2 µm optical isolators

In conjunction with Southampton ORC, G&H has measured the Verdet constants (from 1200-2400 nm) of a wide variety of materials using a supercontinuum source. Existing isolator materials such as terbium gallium garnet (TGG) and yttrium iron garnet (YIG) have been characterised as well as novel candidates, such as CdMnTe and ZnSe, which have been suggested in the literature as being suitable for use at 2 µm. Through this work in ISLA, a group of materials possessing an even higher rotation than YIG has been found, and is now being developed at G&H into optical isolators.



Graphs of the measured performance of one G&H prototype 2 µm optical isolator showing good isolation and low loss across the entire measured bandwidth

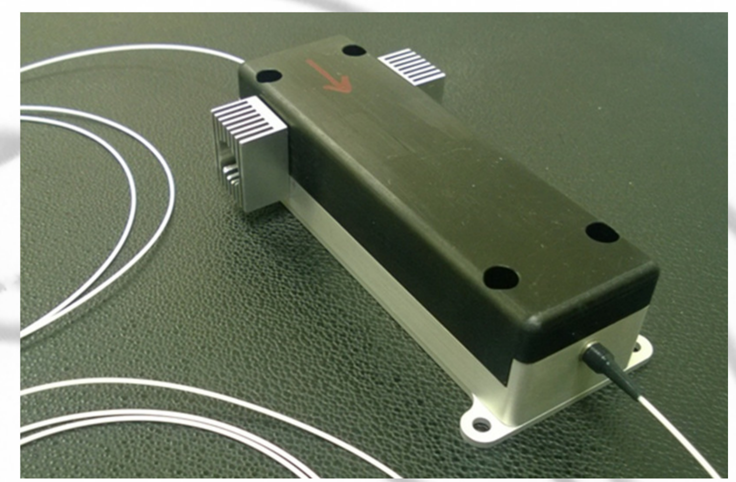
Isolation (blue line; LH axis)

Insertion loss (red line; RH axis).

The prototype isolators currently being manufactured are both fibre-in fibre-out ("FIFO") and fibre-in beam-out ("FIBO") devices. These compact devices include modular heat sinks and demonstrate high isolation and low insertion loss.

Right: Protoype ISLA FIFO format 2 µm isolator which has been fabricated at G&H.

For more info contact Gary Stevens: gstevens@goochandhousego.com



Graphene modelockers

TRINITY COLLEGE DUBLIN
COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH

ISLA researchers at Trinity College Dublin have been working on 2 µm modelockers based on graphene. These devices include "bulk" devices, for free space beams, and also fibre-based modelockers for use within fibre laser architectures. Some of the techniques can be transferred from one design regime to the other.

Deposition procedures

The procedure to prepare the filtration graphene film onto fused silica involves two steps. The first is to prepare the graphene film on a filter membrane. Then it may be transferred onto the surface of a fused silica substrate. Within ISLA, the graphene flakes are prepared using the liquid phase exfoliation (LPE) method.

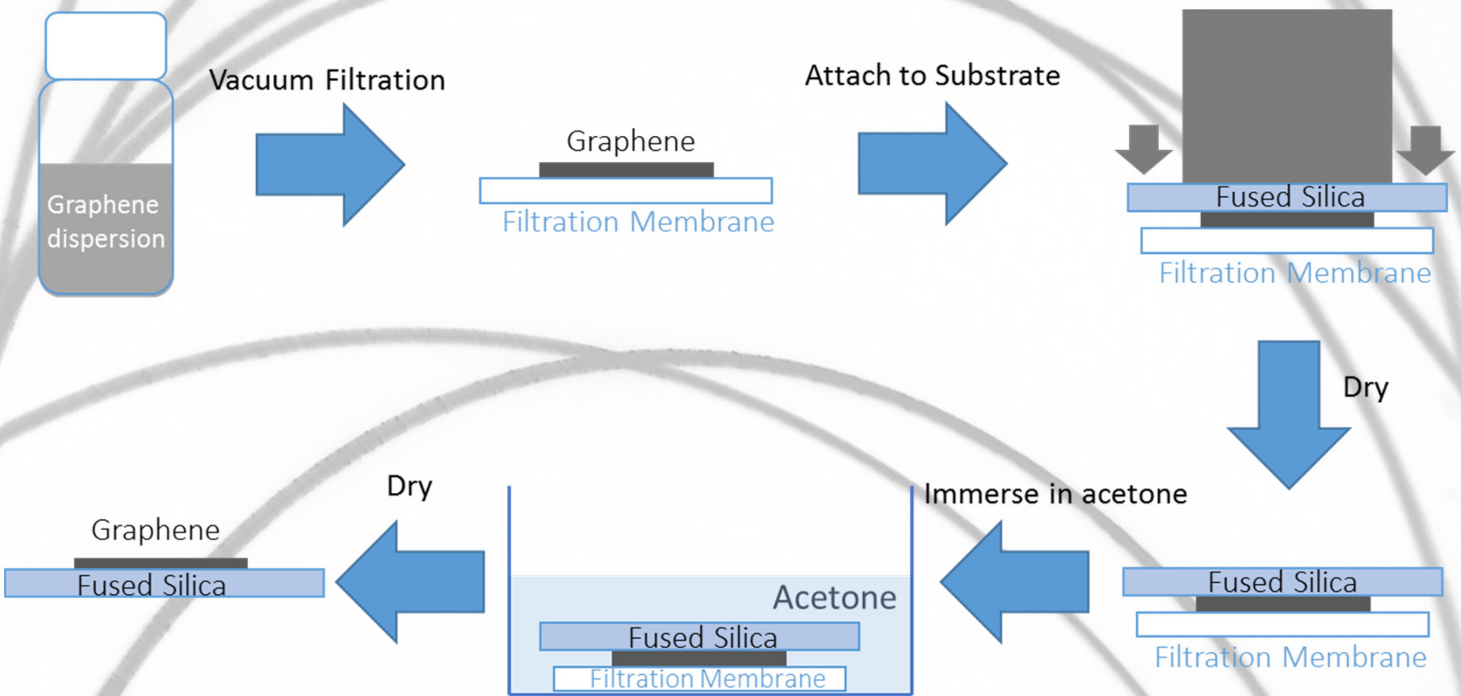
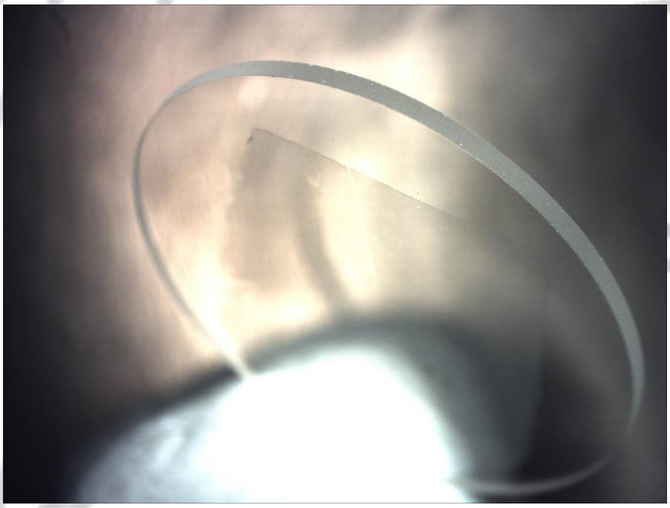


Diagram of vacuum filtration deposition

Vacuum filtration

- In order to make the filtration film more homogeneous, 0.5 ml LPE-prepared graphene dispersions with surfactant in H_2O is diluted to 100 ml, then ultrasonically agitated for 30 min.
- A cellulose ester filtration membrane is installed in the apparatus
- The graphene dispersion is added slowly into the filter. When the filtration process is complete the graphene filtration film on the membrane can be extracted.

The vacuum filtration devices at TCD



Vacuum filtration samples deposited on a 1 inch quartz substrate

Film transfer method

- Wet the graphene filtration membrane with water, then attach the graphene film on the filtration membrane onto the surface of the target cleaned fused silica. It is important that the contact is firm and bubbles are avoided.
- Place a heavy weight on the fused silica side and dry.
- Immerse the filtration membrane together with fused silica into acetone for several hours to dissolve the membrane.
- Lift the graphene on fused silica out of the acetone, then gently wash repeatedly with ethanol and finally dry.
- The final product is shown opposite.

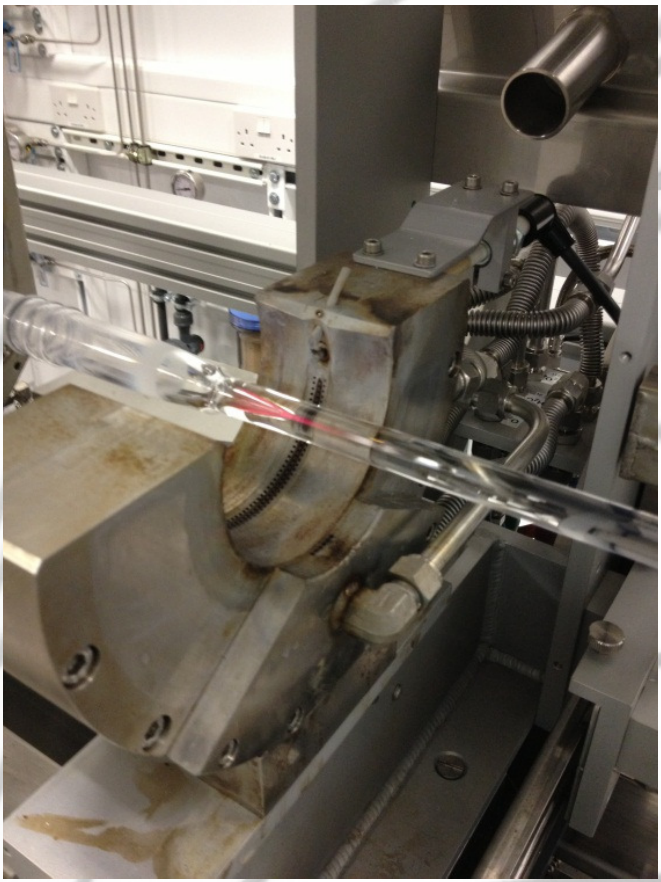
For more info contact Prof. Werner Blau (Trinity College Dublin)
wblau@tcd.ie

JDSU acquisition of Time Bandwidth Products

Since the last newsletter, it was reported that on 26-Jan-2014, JDSU closed the acquisition of Time-Bandwidth Products. JDSU (NASDAQ: JDSU; and TSX: JDU) innovates and collaborates with customers to build and operate the highest-performing and highest-value networks in the world. JDSU develops and markets high-powered commercial lasers for a range of applications. The acquisition strengthens Time Bandwidth Products as an ISLA partner.

Rare-earth doped Tm and Ho fibres for high power lasers

UNIVERSITY OF Southampton Optoelectronics Research Centre



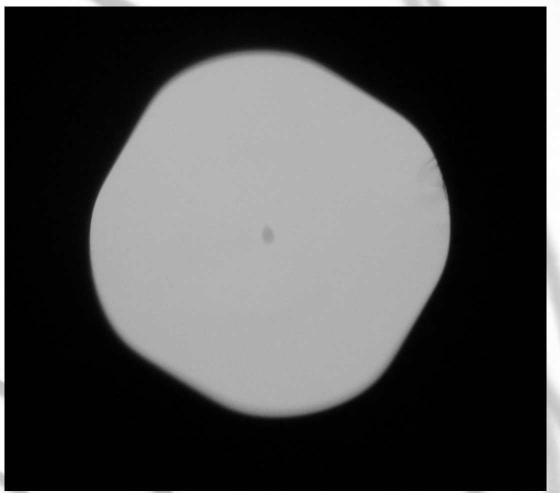
Showing fabrication of a Tm-doped preform. The collapsed preform is on the RHS and the intact source gas feeder tube is on the LHS. The Tm ion thermal fluorescence from the preform core is seen glowing red.

At the ORC the process of development of ISLA Tm- and Ho-doped fibres for high power laser operation has continued. This development work has pushed the slope efficiencies of ORC Tm fibres to the 70% target level for operation within the 2 µm band, pumped at 793 nm. This has been accomplished through minimisation of the core OH contamination and optimisation of the Tm and Al composition within the preform. The figure (left) shows the thermal fluorescence of a Tm-doped preform at the end of fabrication with the collapsed preform on the right hand side. Holmium-doped fibre development has continued with optimisation of composition for high efficiency operation when pumped by a Tm fibre laser.

Focus of development has subsequently shifted into creating a platform of compatible active, passive and photosensitive fibres. Refractive index profile matching has been undertaken to provide low loss splicing from active to passive fibres in order to facilitate the high power laser operation demonstration systems.

The micrograph (right) shows a cross-section of the ISLA Tm double clad fibre with a quasi-octagonal glass structure in order to break the symmetry and allow efficient absorption of the 793 nm pump light.

Further optimisation of the device fibres is underway for integration into the ISLA demonstration systems.



Showing the double clad ISLA Tm fibre.

For more info contact Dr. Peter Shardlow (ORC)
peter.shardlow@soton.ac.uk

Join the ISLA Advisory Group!

If you would like to find out more and be involved with the project please contact Bruce Napier bruce@vividcomponents.co.uk