IMPROV

SELECTIVE LASER STRUCTURING OF OPV STACKS

Innovative Mid-infrared high Power source for resonant ablation of Organic based photovoltaic devices

An EU FP7 collaborative project

Project organisation

- STREP
- Seventh Framework Programme
- ICT-2009.3.7 Photonics
- 3-years: 1 September 2010 to 31 August 2013
- Total budget of 2.43 M€ (EC contribution)
- Grant Agreement no: 257894
- Two global players, two SME‘s, three research institutes

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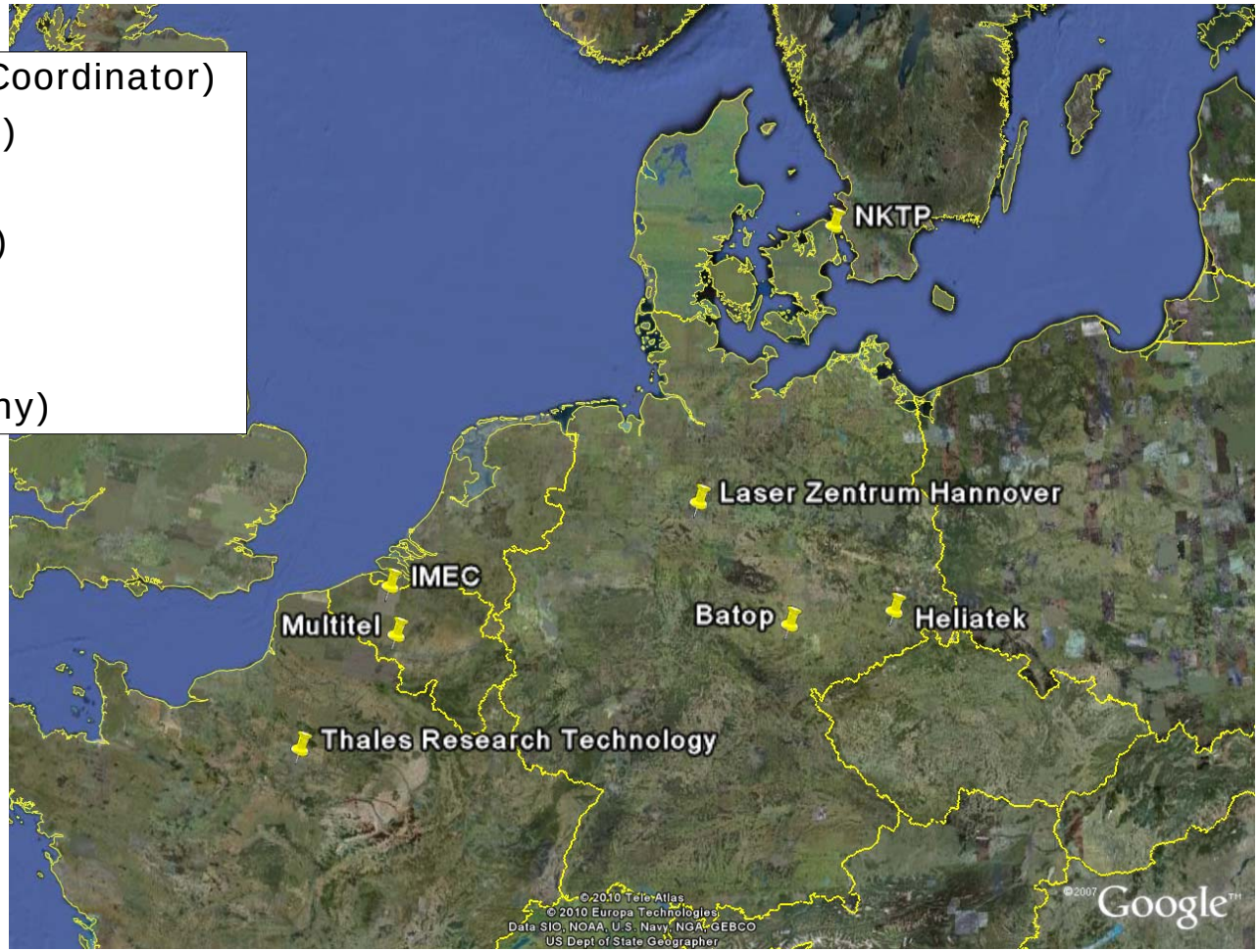
Consortium

SEVENTH FRAMEWORK PROGRAMME

- LZH (Germany, Coordinator)
- Multitel (Belgium)
- NKTP (Denmark)
- Batop (Germany)
- TRT (France)
- IMEC (Belgium)
- Heliatek (Germany)



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Project overview

SEVENTH FRAMEWORK PROGRAMME

IMPROV develops a short-pulse Mid-IR laser system, based on a multi-stage configuration operating at wavelengths between 3 – 10 µm using novel

- Tm fibre oscillator operating between 1.8 and 2 µm as seed-source
- high power Tm fibre amplifier chain as front-end
- efficient OPG/OPA based nonlinear wavelength conversion stage with orientation patterned GaAs, providing radiation in the MIR
- and required components for integration

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Project overview

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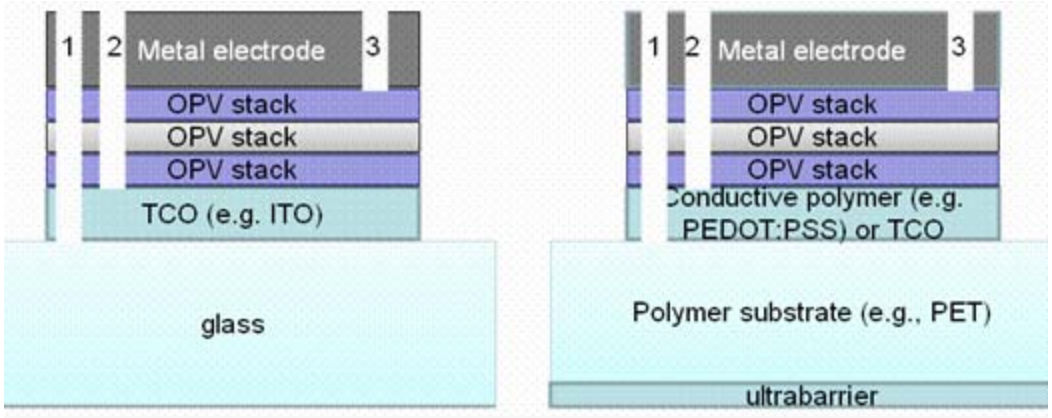
IMPROV evaluates resonant infrared ablation (RIA) of organic photovoltaic (OPV) stacks with the developed laser system

- integration in a process ablation set-up
- scribing tests of single/multilayer elements



Schematic view of the 3 processes steps in the fabrication of an OPV

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Project overview

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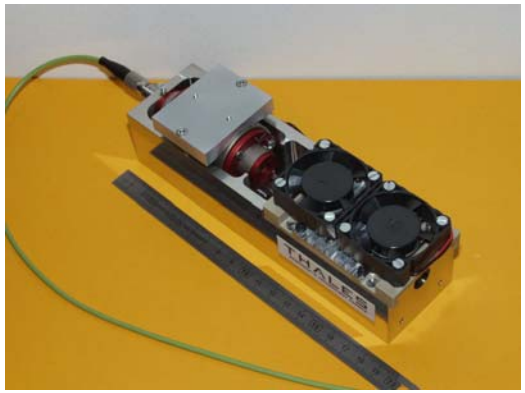
IMPROV demonstrates the functionality of the Mid-infrared tunable laser source concerning

- mechanical and optical parameters
- integration/compatibility with a practical industrial application



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Workplan

SEVENTH FRAMEWORK PROGRAMME

Tasks	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	10	Q11	Q12
2.1.1: Laser design studies												
2.1.2: Determination of optimum parameters of saturable aborber												
2.2.1: Reflective saturable absorber												
2.2.2: Transmission saturable absorber												
2.2.3: Fibre coupled saturable absorber												
2.3.1: Development of fibre components												
2.3.2: Preliminary prototype operating at a wavelength of 1.98 µm												
2.3.3: Low repetition rate fibre laser operating at 1.98 µm												
2.4.1: Design considerstions												
2.4.2: Tunable fibre oscillator												
2.4.3: All-fibre tunable oscillator				Fixed wavelength fibre osc.								
3.1.1: Research and test of available 2 um fibre comp. from market									Tunable fibre oscillator			
3.1.2: Development of a low power all-fibre amplifier												
3.1.3: LMA preamplifier fibre												
3.1.4: LMA core and cladding pumping evaluation												
3.1.5: ASE filtering												
3.1.6: Prototyp. of the LMA double-clad amp. and int. short pulse laser												
3.2.1: First iteration single clad Booster PCF (case of core pumping)												
3.2.2: All-fibre pump/signal multiplexer (case of clad pumping)												
3.2.3: Characterisation of the 50 µm LMA PCF												
3.3.4: Test of broadband amplification												
3.2.5: Prototyping of the High power Tm-lasers		First prototype with preamplifier										
4.1.1: Nonlinear crystal design and fabrication										High power system		
4.1.2: Design of the OPG/OPA set-up												
4.1.3Assembly of pulsed prototype										Second prototyp with tunable osc./amp.		
4.2.1: Nonlinear crystal design and fabrication												
4.2.2: Design of OPG/OPA set-up												
4.2.3: Assembly of pulsed prototype II			First prototype MIR laser source									
5.1.1: Single layer characterisation: small mol. absorb. and pol. substr.												
5.1.2: Gas barriers for flexible devices												
5.1.3: Preparation of samples for scribing tests												
5.2.1: Preparation of the scientific ablation set-up												
5.2.2: Integration of the preliminary laser source												
5.3.1: Scribing tests on single layer elements with preliminary laser												
5.4.1: Integration of first tunable laser prototype												
5.4.2: Multilayer ablation tests							Integration of second prototype					
6.1.1: Nonlinear crystal selection												
6.1.2: Demonstrator integration and final tests												

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5.4.1: Integration of first tunable laser prototype
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6.1.1: Nonlinear crystal selection
6.1.2: Demonstrator integration and final tests

Integration of second prototype

WP2: Saturable absorber and laser oscillator

Lead Participant: LZH

Development of Thulium-based integrated all fiber oscillators

- wavelength range 1.8 to 2.0 µm
- pulse duration from 10 ps to hundreds of ps
- repetition rate < 1 MHz
- average output power 10 mW

and related components

- saturable absorbers
- fiber combiners
- wavelength division multiplexers

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2.3.3: Low repetition rate fibre laser operating at 1.98
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5.4.1: Integration of first tunable laser prototype
5.4.2: Multilayer ablation tests
6.1.1: Nonlinear crystal selection
6.1.2: Demonstrator integration and final tests

Integration of second prototype

WP3: Photonic crystal fibre, combiners and amplifier integration

Lead Participant: MULT

Development of the high power amplifier chain

- wavelength 2 µm
- spectral linewidth 1 nm
- pulse duration < 1 ns
- energy per pulse 100 µJ

and related components

- LMA photonic crystal fibres
- LMA pump/signal combiners/multipexer based on crystal fibres

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6.1.2: Demonstrator integration and final tests												

WP4: Mid-IR tunable laser source prototyping

Lead Participant: TRT

Development of a mid-infrared laser source

- wavelength range from 2.5 µm to 11 µm
- pulse duration < 1 ns
- repetition rate < 1 MHz
- energy per pulse up to 30 µJ
- 10 µJ pulse energy at 6 µm wavelength

and related components

- nonlinear crystal design, characterisation and fabrication

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6.1.2: Demonstrator integration and final tests												

WP5: Resonant infrared ablation for structuring OPV

Lead Participant: IMEC

Validation of the mid-infrared laser source for structuring organic photovoltaic material stacks

- IR absorption measurements/characterisation
- preparation of the process evaluation set-up
- integration of the fixed wavelength laser source
- single layer ablation tests
- integration of the tunable laser source
- multilayer ablation tests

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5.4.2: Multilayer ablatio												
6.1.1: Nonlinear cr...al selection												
6.1.2: Demonstrator integration and final tests												

WP6: Validation of the Mid-infrared laser source

Lead Participant: TRT

Demonstration of the overall functionality of the MIR source concerning

- mechanical and optical parameters
- integration/compatibilitywith practical industrial applications

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Research areas

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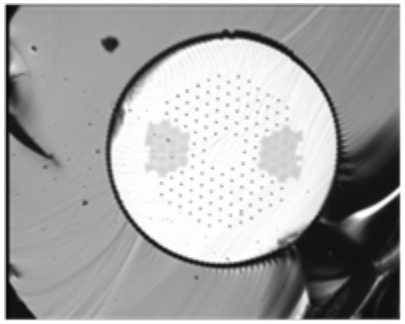
Multi-functional Components

- Saturable absorbers
- Fibre couplers
- PCF based devices
- nonlinear crystals



Resonant Infrared Ablation

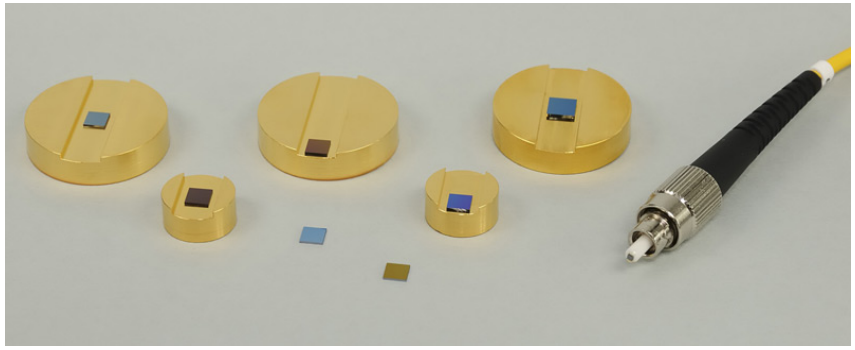
- sample preparation
- process evaluation set-up
- ablation tests

Tunable short pulse radiation systems

- Mode-locked Tm fibre oscillators
- Tm fibre amplifiers
- GaAs nonlinear conversion stage

Integration, Opto-Mechanical Engineering

- components
- subsystems



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