



E.U. Projects at Thales Research and Technology (TRT)

Department of semiconductor components and technology
Domaine de Corbeville, 91404 Orsay Cedex

Theme: Quantum Cascade Lasers

Project leader: Hideaki Page

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Réunion nationale d'information sur le programme NMP 13-1-2005

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My Background

5th Framework projects

UNISEL (STREP)	co-ordinator	Thales
SUPERSMILE (STREP)	co-ordinator	Technical University of Vienna
WANTED (STREP)	co-ordinator	Cavendish labs

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ANSWER

Artificial Nano-materials for Short Wavelength Emission in the Infrared

Call: NMP nanotechnology and multifunctional materials

STREP Start date: 1-2-2004

Duration: 3 years

Total Funding: 1.8Meuros

Thematic area 3, Nanotechnology, knowledge based
multifunctional materials, new production processes
and devices”,

3.4.2 knowledge based multifunctional materials.

3.4.2.1 Development of fundamental knowledge

3.4.2.3 Engineering support for materials design

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13-01-2005, 13-01-2005, 13-01-2005, 13-01-2005

Consortium

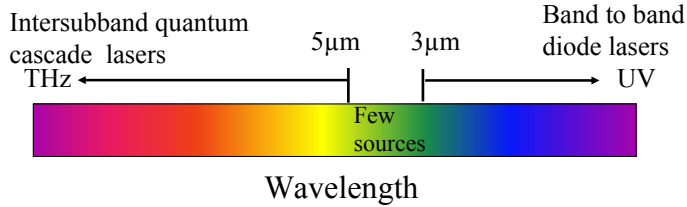
Thales Research and Technology	France
University of Neuchatel	Switzerland
Alpes Laser (SME)	Switzerland
Fraunhofer Institute	Germany
University of Sheffield	UK
University of Paris VII	France
INFN Bari	Italy
Technical University of Vienna	Austria

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The Problem



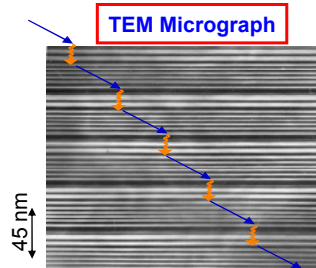
Wavelength	T _{max} (pulsed)	T _{max} (CW)	Date
3.5μm	280K	50K	1998
4.6μm	320K	110K	2002

Goal: 3-5μm band room temperature quantum cascade lasers

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The ANSWER to the call

Semiconductor nano-technology



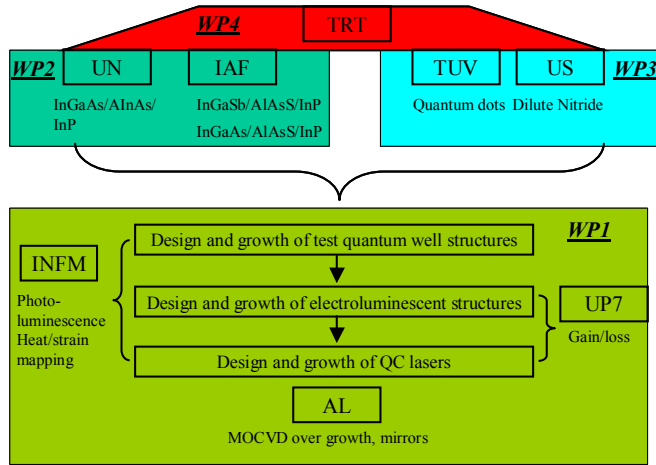
quantum cascade laser

New semiconductor materials = new lasers

- | | |
|----------------------|-------------------------------------|
| Short term concepts | Strain balance InGaAs/AlInAs on InP |
| Medium term concepts | InGaAs/AlAsSb on InP |
| Long term | Quantum dots and dilute nitrides |

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Flow Diagram



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Gantt Chart

WP1	Materials design and characterisation	Month					
		6	12	18	24	30	36
1.1	Conception of new quantum materials						
1.1.1	Band structure calculations of heteromaterials for the building blocks of QC structures						
1.2	Design of QC structures						
1.3	Characterisation and data analysis for material and design feedback						
1.3.1	Intersubband absorption measurements						
1.3.2	Interband photoluminescence						
1.3.3	Characterisation of strain incorporation limit						
1.3.4	Material Gain loss measurements						
1.3.5	QC device characterisation						
1.4.1	Fabrication of low loss optical cavities						
1.4.2	MOCVD overgrowth of InP for buried heterostructures QC lasers						
1.4.3	Study on the temporal nature of heat flow in layered nanostructures						
WP2							
2.1.2	AlInAs/InGaAs strain compensated on 111*						
2.1.3	AlSbAs/GaInAs lattice matched on InP 100*						
2.1.4	AlSbAs/GaAsSb lattice matched on InP 100*						
2.1.5	AlSbAs/GaAsSb strain compensated on InP 100*						
2.3	Growth of structures (applicable to all materials in WP2)						
2.3.1	Growth of test layer/QW structures						
2.3.2	Growth of QC structures						
2.3.3	Growth of QC lasers						
WP3	Advanced material concepts for unipolar optoelectronics						
3.1	InAs self organised quantum dots on GaAs						
3.1.1	Growth of quantum dots						
3.1.2	Stacked quantum dot structures						
3.1.3	Seeding of quantum dot structures						
3.1.4	QC device with quantum dots in active region						
3.2	InAs self organised quantum dots on InP						
3.3	GaNAs/AlGaAs on GaAs						
3.4	GaNInAs/AlGaAs lattice matched on GaAs						
3.5	GaNInAs/AlInAs on InP						
WP4	Management						
	* the same pattern of activities is repeated in each material. Pattern given 2.3.1, 2.3.2, 2.3.3						

Follow time line 2.3.1 to 2.3.3

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Evaluation Summary Report for a STREP

Proposal No. : 505642-1	Acronym : ANSWER
1. Relevance (Threshold 3/5; Weight 1) The development of new class QC LASERS have objectives well aligned with the NMP priority.	Mark: 4
2. Potential impact (Threshold 3/5; Weight 1) There is sufficient expertise in the project for succeeding in the development of new devices of LASERS in the 3-4µm wavelength range. If successful, an important impact in free space communication and spectroscopic trace gas detection applications is expected.	Mark: 4.3
3. S&T excellence (Threshold 4/5; Weight 1) Project tasks and objectives are clearly defined in the project work programme to be carried out by highly specified and skilled partners. However, more detailed and measurable milestones are to be set.	Mark: 4.3
4. Quality of the consortium (Threshold 3/5; Weight 1) The consortium is of high quality. Partners expertise and skills in the field are expected to result successfully in bringing a competitive edge to EU in the field of LASERS using new design and materials.	Mark: 3.8
5. Quality of the management (Threshold 3/5; Weight 1) Better integration of effort and its distribution across the work packages should be achieved more effectively. IPR and exploitation of technology issues need to be further addressed by the partners.	Mark: 3.5
6. Mobilisation of the resources (Threshold 3/5; Weight 1) Almost all partners are able to design, analyse and characterise new devices. Therefor a better integration and focus on potentially important devices are recommended. This will also avoid the duplication of effort in work packages, especially in WP1. WP4 (services work) by AL+INFM+TUV that is not clearly justified.	Mark: 3.4
Overall remarks (Threshold 21/30) The proposal is recommended for its scientific and potential impact. It could however be more focused, hereby also limiting the scope and resources of this basic research phase. An overall budget reduction of 35% resulting in a maximum recommended funding of 1.800.000 should thereby be achieved.	Total score: 23.3
Has the proposal passed all evaluation thresholds?	Yes
Does this proposal have ethical issues that need further attention?	No

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Negotiations

Requested budget 2.7 Meuros

After E.U. demands 1.8 Meuros

Budget pre-written by project officier
No choice take it or leave it

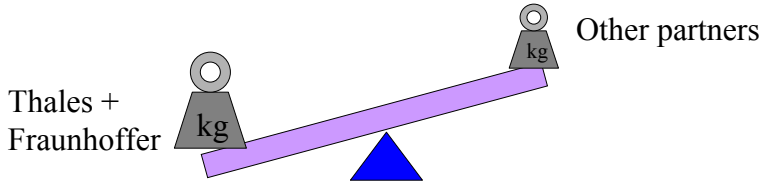
However, reduced deliverables and targets

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Lessons

Too many big players in the consortium demand a large share of the budget



Be prepared for a reduced budget ~20-35%

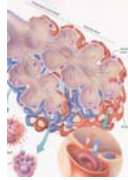
Reporting in 6th Framework more demanding than in 5th Framework

EXCELS

Exhaled breath analysis of Complex bio-molecules Elucidated by Laser Spectroscopy

TRT	France
Sheffield	UK
Alpes	Switzerland
Paris VII	France
Vigo	Poland
LENS	Italy
Leipzig	Germany

EXCELS Overview



Exhaled Breath

Gas NO, CO₂ etc

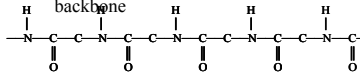
Moisture, Aerosols, dissolved gases and compounds

Complex biological compounds:
Cytokines, arachidonate metabolites,
Cyclooxygenase, DNA

Man Machine
interface

Protein

backbone



Cytokine

Broad mid-infrared absorption

bands	Coil	Helix	Sheet	
Amide A	3250 cm ⁻¹ 3.077 μm	3290 cm ⁻¹ 3.040 μm	3290-3260 cm ⁻¹ 3.040-3.067 μm	NH stretch
Amide I	1655 cm ⁻¹ 6.006 μm	1650 cm ⁻¹ 6.024 μm	1630 cm ⁻¹ 6.135 μm	C=O stretch
Amide II	1520-1545 cm ⁻¹ 6.579-6.472 μm	1545-1550 cm ⁻¹ 6.472-6.452 μm	1520-1530 cm ⁻¹ 6.579-6.534 μm	C-N stretch NH bend

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STREP EXCELS EVALUATION SUMMARY REPORT

- 1. Relevance (Threshold 3/5) 2**

The proposal represents a nice work on the spectroscopic analysis of exhaled breath for diagnostic healthcare. Nevertheless no biosensors development is presented. IST-NMP priorities are not addressed.
- 2. Potential Impact (Threshold 3/5) 3**

This project could have impact on competitiveness in its field but not in that of biosensors. The structure and the detection of the complex biomolecules depends on several parameters like pH, humidity, the function of alveolar macrophages etc. and all those should be considered to the interpretation of the analytical results so as to preview their real impact. Issues on reinforcing competitiveness of SMEs are not addressed. The European added values are clear but the exploitation plans are not described well.
- 3. S and T Excellence (Threshold 4/5) 4**

The first part of the project focuses on the laser spectroscopy of the analytes and it is clearly defined and with well focused objectives. Nevertheless the proposed special spectroscopic method seems to require more basic research before being of use in this project. In the second part of the project the limitations of the structure analysis of cytokines need further considerations before the medical or biological relevance of the objectives can be justified. WP3 is not thoroughly developed.
- 4. Quality of consortium (Threshold 3/5) 4**

The quality of the consortium is high. The complementarities of the team would be improved by the incorporation of protein / peptide biochemist to bridge the gap between laser physicist and medical experts on lung diseases or intensive care specialists. SMEs in the field of laser technology are involved in the project.
- 5. Quality of management (Threshold 3/5) 4**

The management of the project is appropriate. The IPR issues are not outlined.
- 6. Mobilisation resources (Threshold 3/5) 4**

The mobilization of resources is described in details. Less effort is included to have sufficient competence in the interpretation of the protein structure data in terms of diagnostic results.

Overall remarks (Threshold 21/30)

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