

# NEW - DfMM TRAINING COURSE

## Thermal Issues in MEMS

an intensive introduction to the significant effects of heat transfer, modelling and measurement

### some of the areas covered in this course:

#### Heat transfer Basics and Modelling Techniques

Analysis of Conduction - Basics of heat conduction and resistance.

The concepts and simulation of compact (lumped, reduced order) models.

Analysis of Radiation and Convection

Fluid properties and influence on convection. Viscosity (dynamic vs. kinematic), density, heat capacity, etc.

"Magic" numbers: Prandtl, Biot, Reynolds, Grashof, etc.

Numerical modelling – Computational Fluid Dynamics, and Examples of CFD simulations

#### Testing Techniques

Thermal Testing, Power Cycling, Test chips

Temperature measurement methods (IR, ...)

Thermal Resistance of Interface Materials

Thermal transient testing by test equipment and by intelligent thermal test chips

Driving point and transfer impedances

Time-constant spectra, complex loci of impedances

Results evaluation, Structure function based analysis

Case studies and hands-on demonstrations

Applicable JEDEC standards for package characterization

#### MEMS and NEMS Thermal Management

Scaling effects on conduction & convection from Micro Scale to Nanoscale

Heat generation and dissipation in MEMS

Thermal and Thermoelastic actuators

Thermal cycling of fluids

Thermal management of electronic systems using MEMS

Microchannel cooling, Micro-pumps & Micro-fans



**10-11 January 2006 at  
Fraunhofer IZM, Berlin,  
Germany**

### Presenters

Olaf Wittler, Fraunhofer IZM, Berlin

Andras Poppe, Marta Rencz, BUTE, Budapest

Nicolas Cordero, Tyndall Institute, Cork

**Course Fee: 450 Euros + VAT**

Fees include tuition, course notes, lunches and light refreshments. Discounts are available for PATENT students.

### To register please contact:

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Delegates must register by completing form at:  
( [www.patent-dfmm.org/training/register.htm](http://www.patent-dfmm.org/training/register.htm) )

Credit Card payment (VISA / MasterCard) preferred. A 10% administration fee is charged for cancellations made more than 2 weeks before the start of the course. Cancellations of 2 weeks or less will be liable to the loss of the full fee. Substitutions may be made at any time until the start of the course. ISLI reserves the right to cancel any course at short notice or to postpone or make necessary alterations to the content. If a course is cancelled by ISLI, course fees will be refunded in full however no further liability is accepted for expenses including alterations to travel arrangements. The course is presented in English.

### Enquiries

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The "Design for Micro & Nano Manufacture (Patent-DfMM)" Network of Excellence aims to establish a new technical community targeting the underlying engineering science to ensure that problems affecting the manufacture and reliability of products based on MNT can be addressed before prototype and pre-production.

The work involves teams from the fields of packaging, test engineering, reliability engineering, simulation and modelling, drawn from 24 partner institutes and industries in Europe.

