

Cherry Biotech
Flow Capture

école normale supérieure paris-saclay



University of Nottingham
UK | CHINA | MALAYSIA



ELVESYS
Innovation Center

YORK UNIVERSITY



Stanford University

5 Continents = 12 Countries = 18 Partners

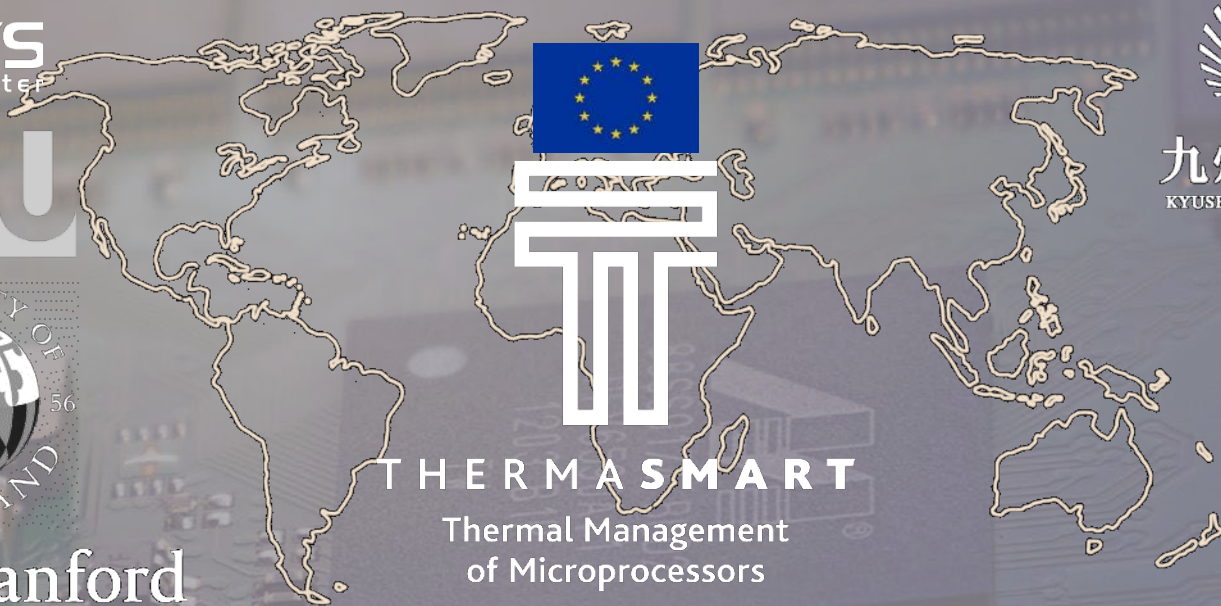


UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA



INTERNATIONAL CENTRE for THEORETICAL SCIENCES

TATA INSTITUTE OF FUNDAMENTAL RESEARCH



THERMASMART
Thermal Management of Microprocessors



九州大学
KYUSHU UNIVERSITY



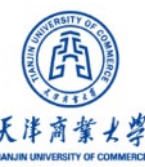
European Commission RISE Award

Research and Innovation Staff Exchange

Started on 01 December 2017

ThermaSMART

Smart thermal management of high-power microprocessors using phase-change

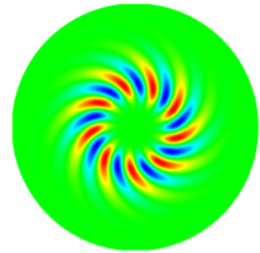
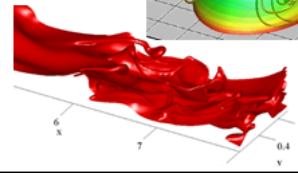
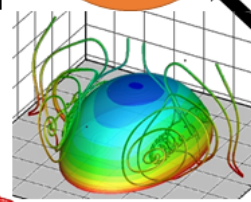
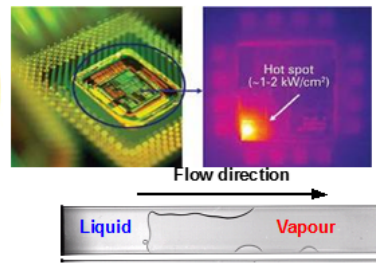
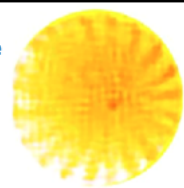
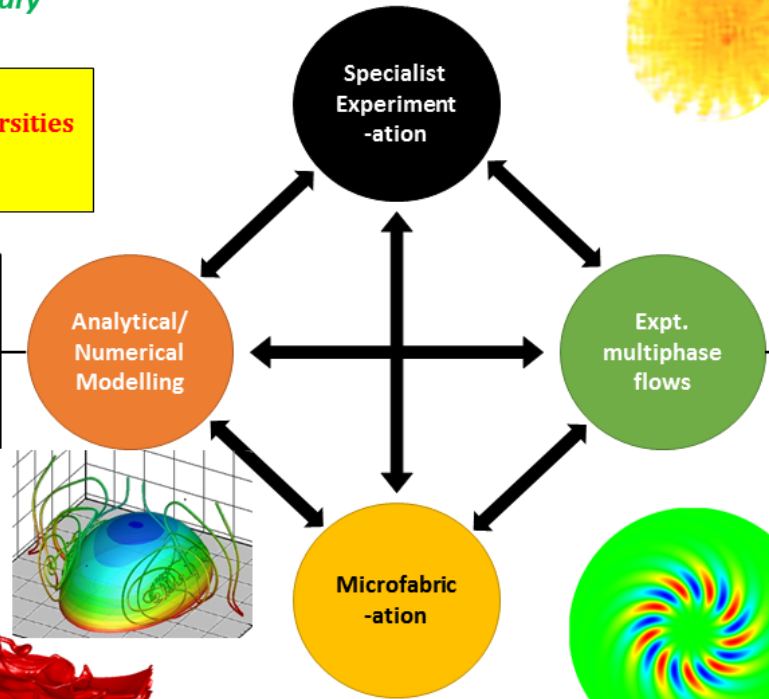


ThermaSMART
Global and Interdisciplinary
Research Collaboration

Edinburgh, Kyushu, Kobe, York Uni Toronto,
Maryland, Pretoria, Tianjin UC, Flow Capture

- Highlights**
- 15 World-leading Universities
 - 3 EU-based Industries
 - 5 continents

- Nanoscale**
Polish Inst. Physics, Nottingham,
Saclay-Paris
- Mesoscale**
Pol. Inst. Physics, Nottingham,
Paris-Saclay, Dalian
- Micro/milliscale**
Edinburgh, Dublin, TIFR
Bangalore, Rio, Nottingham,
Kobe, Paris-Saclay



KEY
RED - ACADEMIA
BLUE - INDUSTRY

Edinburgh, Kyushu, Stanford,
Elvesys, Cherry Biotech



Coordinator



The University of Edinburgh (UEDIN), UK

» Prashant Valluri

» Kate Morris, ThermaSMART Research Support Officer

» UEDIN Finance, Legal and Research Services

European Commission Support

Katarzyna (Kasia) Lyson – EC Project Officer/ Coach/



ThermaSMART Workpackages



WP Number ⁹	WP Title	Lead beneficiary ¹⁰	Co-Lead	Start month ¹²	End month ¹³
WP1	Droplet populations: Evaporation, Vapour phase dynamics and Condensation effects	1 - UEDIN	TIFR	1	48
WP2	Bubble populations: Pool boiling	4 - IF PAN	USMF	1	48
WP3	Multicomponent fluid mixtures: Phase Change	2 - UNOTT	KYUJ	1	48
WP4	Flow boiling and distribution	3 - NUID UCD	UPRE	1	48
WP5	Substrate Design: Patterning for Heat Transfer Enhancement	6 - ENS ParisSaclay	YORKU	1	48
WP6	Management	1 - UEDIN	ALL	1	48
WP7	Impact and Dissemination	1 - UEDIN	ALL	1	48

Note

- A Lead Beneficiary with a Co-Lead are only management leads for the WP. There are of course several other partners involved in a workpackage. *We are all together in this.*
- Refer to the Grant Agreement (Description of Action) which indicates who is involved in each WP



WP1: Droplet Populations

Evaporation, Vapour Phase Dynamics and Condensation

Deliverables (See Grant Agreement for Tasks leading to these deliverables)

Deliverable Number ¹⁴	Deliverable Title	WP number ⁹	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D1.1	Pub: Interfacial stability during phase-change	WP1	3 - NUID UCD	Report	Public	20
D1.2	Opensource Solver for model-ling evaporating and condens-ing droplet populations	WP1	1 - UEDIN	Websites, patents filling, etc.	Public	46
D1.3	Vapour cloud dynamics model	WP1	1 - UEDIN	Demonstrator	Public	24
D1.4	Droplet evolution in physical field	WP1	2 - UNOTT	Report	Public	24
D1.5	Pub: Understanding pin-ning/depinning dynamics at contact line	WP1	4 - IF PAN	Report	Public	24

WP1: Droplet Populations

Evaporation, Vapour Phase Dynamics and Condensation

Milestones that lead to Deliverables

(See Grant Agreement for associated tasks)

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Model development - interfacial instability during phase change	3 - NUID UCD	15	Mathematical model predicting the stability of phase-change systems
MS2	Model development – vapour cloud modelling	1 - UEDIN	24	Mathematical model describing vapour cloud dynamics.
MS3	DNS framework for multiple drop phase change	3 - NUID UCD	35	DNS strategy for simulating phase-change of multiple droplets.

WP2: Bubble Populations

Pool boiling



Deliverables (See Grant Agreement for Tasks leading to these deliverables)

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D2.1	Pub: Population bubble dy-namics during pool boiling	1 - UEDIN	Report	Public	36
D2.2	Active control of nucleation	4 - IF PAN	Report	Public	24
D2.3	Effects of gravity on nuclea-tion/ boiling	9 - UP	Report	Public	46



WP2: Bubble Populations

Pool boiling

Milestones that lead to Deliverables

(See Grant Agreement for associated tasks)



Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS4	Literature review on bubble populations	1 - UEDIN	12	Literature review on bubble populations during boiling.
MS5	Equipment commissioning and ready for experiments on bubble populations during pool boiling	1 - UEDIN	12	Pool boiling experimental rig commissioning.



WP3: Multicomponent Fluid Mixtures

Phase change

Deliverables (See Grant Agreement for Tasks leading to these deliverables)



Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D3.1	Pub: Interfacial instabilities on multicomponent liquids subject to phase-change	3 - NUID UCD	Report	Public	24



WP3: Multicomponent Fluid Mixtures

Phase change

Milestones that lead to Deliverables

(See Grant Agreement for associated tasks)



Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS6	Model development – for multicomponent sessile droplets	1 - UEDIN	24	Multicomponent droplets - modelling strategy development.
MS7	Experiments for multicomponent sessile droplets	12 - KOKURITSU DAIGAKU HOJIN KYUSHU DAIGAKU	18	Multicomponent droplet evaporation - experiments - at Kyushu and Edinburgh



WP4: Flow Boiling and Distribution

Microchannel design



Deliverables (See Grant Agreement for Tasks leading to these deliverables)

Deliverable Number¹⁴	Deliverable Title	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
D4.1	Design principles for phase-change cooling chips	9 - UP	Report	Public	40
D4.2	Pub: Flow boiling in micro/millichannels	2 - UNOTT	Report	Public	42



WP4: Flow Boiling and Distribution

Microchannel design

Milestones that lead to Deliverables

(See Grant Agreement for associated tasks)



Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS8	Analysis and optimisation of distributor systems	9 - UP	43	Analysis of optimised distributors at Pretoia, Kobe, Rio and Nottingham
MS9	Experiments on modified arrays of channels complete	9 - UP	31	Experiments on modified and optimised arrays of channels at Pretoria and Edinburgh



WP5: Substrate and Pattern Design

Surface fabrication



Deliverables (See Grant Agreement for Tasks leading to these deliverables)

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D5.1	Pub: design and fabrication principles for substrate pat-terning for optimum heat transfer performance	1 - UEDIN	Report	Public	40
D5.2	CIO porous films for high heat flux two-phase heat trans-fer	17 - STANFORD	Report	Public	40



WP5: Substrate and Pattern Design

Surface fabrication

Milestones that lead to Deliverables

(See Grant Agreement for associated tasks)



Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS10	Testing contact line models for different substrates (experiments)	10 - YORKU	26	Contact line experiments on various substrates at Toronto, Edinburgh and Stanford
MS11	Development of model substrate	4 - IF PAN	46	Modelling an optimum substrate at IPPAS and compared against experiments at Stanford, York Toronto and Edinburgh



WP6: Management

Administration and Housekeeping



Deliverables (See Grant Agreement for Tasks leading to these deliverables)

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D6.1	Project and WP kick-off meeting	1 - UEDIN	Other	Confidential, only for members of the consortium (including the Commission Services)	3
D6.2	ThermaSMART website	1 - UEDIN	Websites, patents filling, etc.	Public	1
D6.3	Progress Report - Year 1	1 - UEDIN	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D6.4	Progress Report - Year 3	1 - UEDIN	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D6.5	Mid-Term Meeting	1 - UEDIN	Other	Confidential, only for members of the consortium (including the Commission Services)	18



WP6: Management

Administration and Housekeeping

Milestones that lead to Deliverables

(See Grant Agreement for associated tasks)



Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS12	Half-yearly workpackage meetings	1 - UEDIN	42	WP meetings in months 6, 18, 30, 42. All participate.



WP7: Impact and Dissemination

Workshops, Summer Schools etc

Deliverables (See Grant Agreement for Tasks leading to these deliverables)



Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D7.1	Annual ThermaSMART Dis-semination Workshops	1 - UEDIN	Other	Confidential, only for members of the consortium (including the Commission Services)	47
D7.2	Summer Schools	9 - UP	Other	Confidential, only for members of the consortium (including the Commission Services)	42
D7.3	Monograph on ThermaSMART	1 - UEDIN	Report	Public	48
D7.4	Special issue volume to collect in archival form outcome of the works	10 - YORKU	Report	Public	48



WP7: Impact and Dissemination

Workshops, Summer Schools etc

Milestones that lead to Deliverables

(See Grant Agreement for associated tasks)



Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS13	Half-yearly Impact and Dissemination meetings	1 - UEDIN	42	Six monthly impact and dissemination meetings in months 6, 18, 30, 42. Attended by All.



Road to Success

Obligations

Who can be seconded

- » ESR (Early Stage Researchers): Registered student @ Beneficiary, Tech staff at Industry etc
- » ER (Experienced Researchers): Permanent Academics, Post-docs registered @ Beneficiaries

Beneficiaries (Get the money)

- » UEDIN – Coordinator & deals with UPRE
- » UNOTT
- » UCD
- » IFPAN
- » ENSP
- » CBT
- » Elvesys
- » Flow Capture

Partners

- » UPRE (funded, dealt by UEDIN)
- » STANU
- » USMF
- » YORKU
- » DMU
- » KOBE
- » KYUJ
- » TIFR
- » TUC
- » UERJ



Road to Success

Obligations



Secondments

- » No Secondment = No Funding
- » Minimum fundable secondment = 1 month = 30 days
- » Split secondments are possible, especially relevant for Experienced Researchers
- » Funding rate per secondment month
 - €2000 (A: Travel + Subsistence reserved for researcher seconded) (can be an allowance)
 - €2500 = €1800 (B1: Research, Network and Training) + €700 (B2: Management)
- » A must be spent only on researcher secondment
- » Unused B (B1+B2) can be used to top-up A but vice-versa not possible



Road to Success

Obligations

Ideas/ Flexibility

- » Ideally A is spent only on researcher secondment
- » Unused B (B1+B2) can be used to top-up A under vice-versa not possible
- » B1 and B2 could be shuffled (as long as appropriate)
- » But **no transfer from A to B**
- » **Unspent B1 can be used to fund may be travel/accomodation of ERs from unfunded Third Country Partners (*YORKU, STANU, USMF, UERJ, KYUJ, KOBE, TIFR, TUC and DMU*)**





Road to Success

Obligations

Compulsory Meetings

- » Half-yearly WP meetings (virtual or physical)
- » Annual ThermaSMART Workshop (Compulsory but location tentative)
 - » TUC/DMU, China (Dec 2018)
 - » MID-TERM MEETING, DUBLIN (June 2019)
 - » Kyushu, Japan (Nov 2019)
 - » York Uni, Canada (Nov 2020)
 - » Edinburgh, UK (Nov 2021)
- » Summer schools (Compulsory but location/ month tentative)
 - » “Advances in Modelling Phase-Change Phenomena” in Dublin (Month 19 along with mid-term meeting)
 - » “State-of-the-Art experimental methods in Phase-Change Based Microdevice Thermal Management” in Maryland (later ...)
 - » “Latest Microfabrication Methods for Phase-Change Cooling Device Development” in Pretoria (Month 42)



Road to Success

Obligations

Publications, Impact and Dissemination

» PUBLISH and PROSPER!

» Acknowledge ThermaSMART

(specific line: *This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 778104 (should be accompanied by the EU flag for presentations, posters etc).*)

» This is EC public money! So disseminate as widely as possible.

» Green Open Access (Compulsory)

» Repository could be institutional (but accessible by all),
Disciplinary (like arXiv) or Zenodo (EC)

» Gold Open Access (Costs can be covered by B costs, could be limited to best publications)



Road to Success

Road so far ... Are we meeting our obligations?

Secondments so far

- » Review – How is it going? Any problems fulfilling your secondment schedule?
- » Must fill up secondment questionnaire after secondment (mandatory for EC, responsibility of beneficiary partners)

Contribution to Major Conferences

- » APS-DFD 2018 (8 talks), IHTC 2018 (3 talks), Anything else?

Upcoming Events – Scientific Dissemination/ Publications

- » Special Session: IUTAM 2019, Dublin, Ireland (June 10-12)
- » Special Session: UK Heat Transfer Conference 2019, Nottingham, UK (Sept 8-10)
- » Special Session: Droplets 2019 Durham UK (Sept 16-18)

Road to Success



Road so far ... Are we meeting our obligations?

Public Dissemination

>> Social Media:

- Twitter channel (already there!)
- Weibo Channel for Chinese audience,
- LinkedIn Professional Page for Networking across the Consortium
- Pass on details to Kate for social media updating!

>> Videos by seconded students

- Examples

>> Further Ideas:

- Desktop demonstrators for Schools and Public Science Events/ Platforms such as Science Express Train in India



Road to Success

Road so far ... Are we meeting our obligations?

Public Dissemination

>> Further Ideas:

- Desktop demonstrators for Schools and Public Science Events/ Platforms such as Science Express Train in India
- Science Festivals



EDINBURGH INTERNATIONAL





Road to Success

Road so far ... Are we meeting our obligations?

Public Dissemination

>> Further Ideas:

- Newsletter contributions (info to Kate)

>> Must fill up dissemination/communication form for EU Web – simple form (pass it on to Kate)



Road to Success



Road so far ... Are we meeting our obligations?

Periodic Report

- » Kate has just sent an email with the form (very simple, shouldn't take more than 10 mins)
- » Beneficiaries + Pretoria only: Just do it now in the next 15 mins or so!
- » Send it back to Kate.



ThermaSMART Workshop 1

3-5 Dec 2018, Tianjin University of Commerce

Chairs for Talk Sessions (25/30 mins + 3 mins QA)



Session	Chair
Monday (14:10-15:30)	Khellil Sefiane, <i>University of Edinburgh, UK</i>
Monday (15:55-17:25)	Lennon Ó Náraigh, <i>University College Dublin, Ireland</i>
Tuesday (9:00-10:35)	Rachid Bennacer, <i>ENS Paris-Saclay, France</i>
Tuesday (11:00-12:05)	Anthony Walton, <i>University of Edinburgh, UK</i>
Tuesday (14:00-15:30)	Liu Bin, <i>Tianjin University of Commerce, China</i>
Tuesday (15:55-17:00)	Yutaku Kita, <i>Kyushu University, Japan</i>
Wednesday (9:00-10:35)	Yuying Yan, <i>University of Nottingham, UK</i>
Wednesday (11:00-11:40)	Panagiotis Theodorakis, <i>Inst of Physics Polish Academy of Sciences</i>





THERMASMART

Thermal Management of Microprocessors



THE UNIVERSITY of EDINBURGH
School of Engineering

Institute for Multiscale
Thermofluids

