

**Transatlantic Degree Programs  
Promoting Internationalization and Global Education:  
Joint and Double Degree Programs in Engineering Education  
between USA, Canada and Germany**

Chicago/USA, June 16 – 18, 2006

**Joint Programs on Graduate Level:  
The Partnership of Technical University of Braunschweig  
with University of Rhode Island**

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**Topics**

- The International Engineering Program
- Non Degree Students
- The Dual Degree Program
- Future Activities



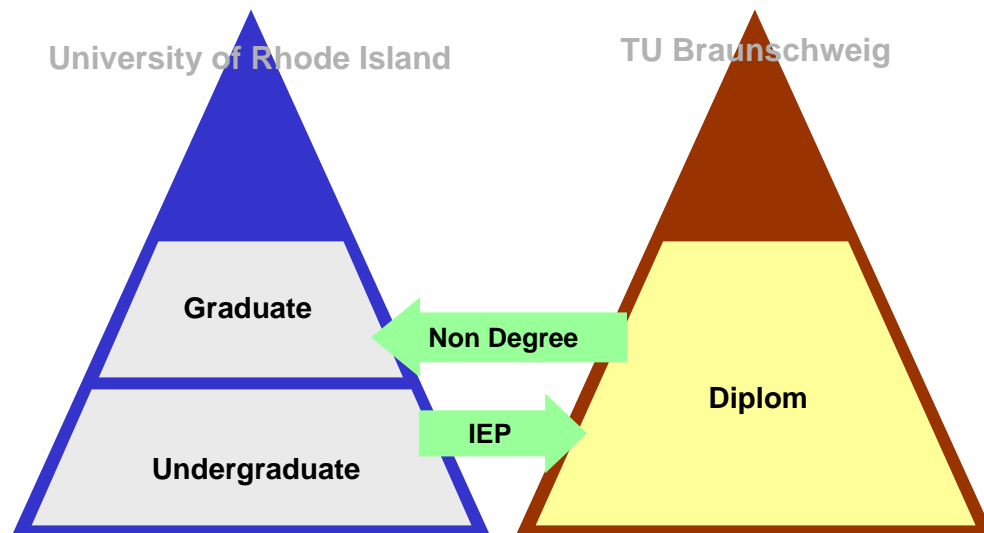
## The International Engineering Program IEP of URI

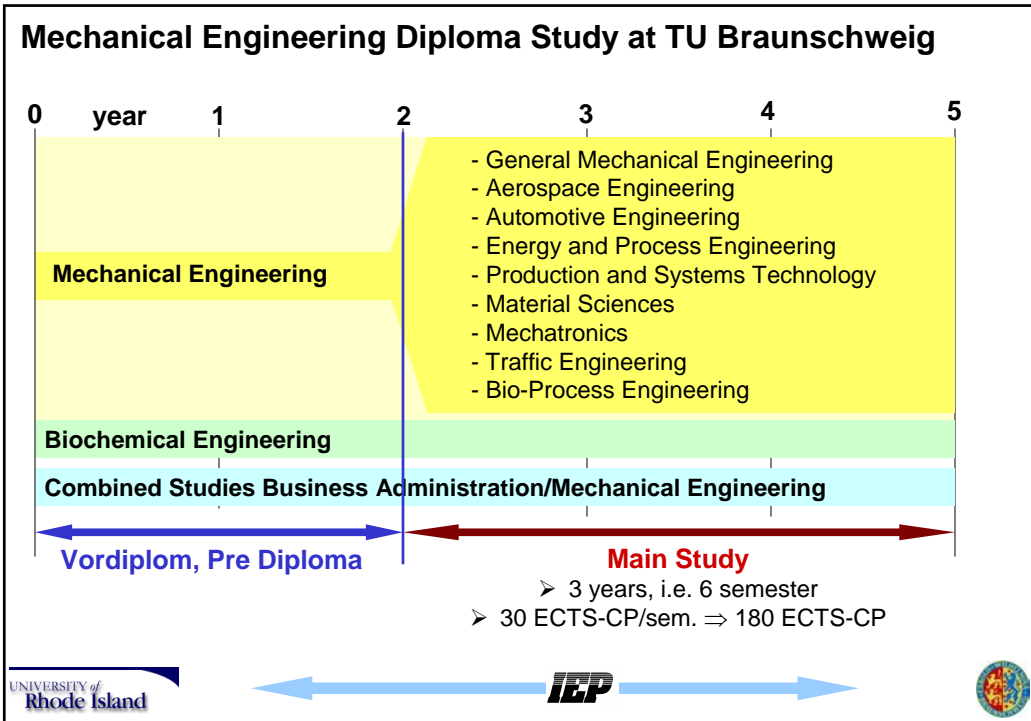


- Five year Dual Degree Program at URI
    - B.A. in Language: German, French, Spanish, Chinese
    - B.S. in Engineering: Chemical, Civil, Electrical or Mechanical Engineering
  - TU Braunschweig's involvement started in 1987
  - Six months of industrial internship abroad in spring semester of fourth year
  - Optional: Additionally one semester of study at TU Braunschweig
    - Intense language courses, Engineering courses & projects
  - URI students pay tuition while being abroad → „vacant places“ for incoming Braunschweig students
- ⇒ Exchange builds on semester-based balance



## Collaboration in Undergraduate and Graduate Education





### Dept. of Mechanical Engineering: Curriculum of Main Study

<b>Required Courses</b> *depending on in-depth branch	<b>20 ... 40 CP *</b>	} <b>Plan of Study</b> 100 CP Courses
<b>Elective Courses</b> *depending on in-depth branch	<b>60 ... 40 CP *</b>	
<b>Free choice Courses</b> technical and non-technical courses	<b>20 CP</b>	
<b>2 Project Works</b>	<b>12 + 12 CP</b>	} 32 CP Project + Lab Work
<b>Laboratory Work</b>	<b>8 CP</b>	
<b>Seminar Presentation</b>	<b>3 CP</b>	} 3 CP Seminar Presentation
<b>Industrial Internship</b> corresponding to 15 weeks	<b>15 CP</b>	} 15 CP Industrial Internship
<b>Diploma Thesis</b> duration 6 months	<b>30 CP</b>	} 30 CP Diploma Thesis
		<b>180 CP ECTS Credit Points</b>

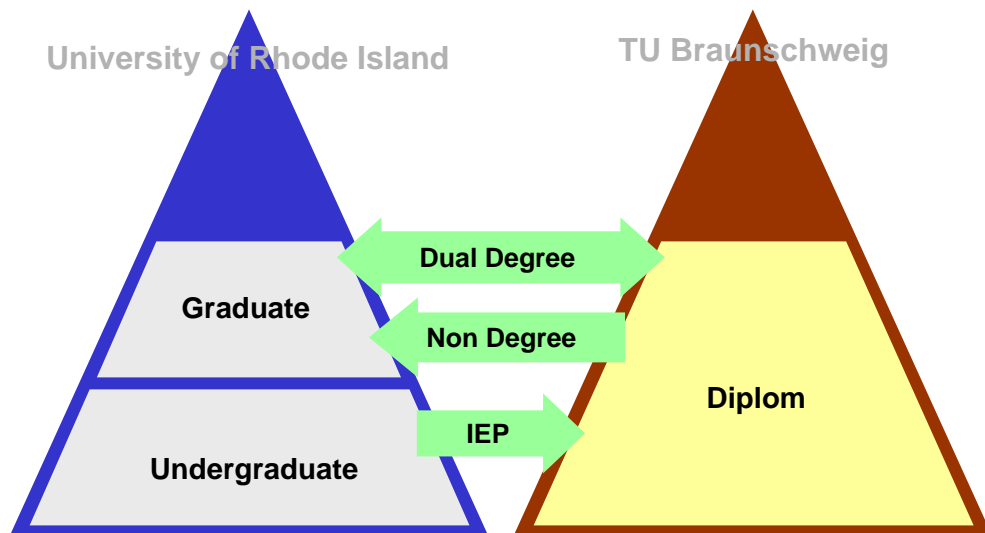
UNIVERSITY of Rhode Island IEP

## Braunschweig Non Degree-Students

- Students go out in 7th semester at the earliest, with one year study in their specialization
- One or two semesters at URI
- Confirmed plan of study with imported courses prior to leave of TU Braunschweig  
→ approved feasibility study
- *Time frame:*
  - March/April 2005: plan for exchange, set up *Plan of Study* with course transfer and equivalancies
  - consult advising professors at TU BS and URI
  - Sept./Oct. 2005: apply for program
  - Dec. 2005: candidates' selection
  - Spring 2006: administrative preparation
  - Sept. 2006: start at URI
- ⇒ 18 ... 24 months of preparation prior to leave
- Students attend courses, labs or prepare study or diploma project at URI  
⇒ import of credits and grades for **Braunschweig Dipl.-Ing. Degree**



## Collaboration in Undergraduate and Graduate Education



## Basic Outlines of the Dual Degree Program

- Through mutual recognition of study elements students obtain two academic degrees at no extra time
- Sending partner selects his candidates with special care in terms of discipline-related, social as well as personal qualification -> no additional selection on the receiving side
- Receiving partner supports incomings through administration, housing, student tutoring, etc.
- Outgoing students are in their final year: TU Braunschweig: 9<sup>th</sup> & 10<sup>th</sup> semester  
URI: 2<sup>nd</sup> year of graduate study
- Program participants spend 12 to 15 months at the partner university
- Incoming students participate in regular study at the host university
- Program participants conduct their study abroad according to local procedures and regulations
- An in-depth immersion into the host academic system is an essential part of the program  
⇒ *Careful planning & mutual trust: Students, academic education, quality of work*



## Requirements for URI Students for Dipl.-Ing. at TU Braunschweig

Study Element	Requirements	Σ ECTS-CP at TU BS
• Courses	25 ECTS-CP • ≥ 10 ECTS-CP from required course catalogue • Σ ≥ 20 ECTS-CP from required & elective courses (Eventually, import for former IEP students)	25 5)
• Lab work	Import from URI	
• Project works	1 x Import: B.S. Thesis 1 x at TU Braunschweig, final report in German	12
• Seminar presentation	Presentation of Study Project, in German	3
• Industrial internship	Import: IEP-Internship or industrial experience	15
• Diploma thesis	Written report in German or English, oral presentation in German	30
	<b>Total</b>	<b>85 ... 90</b>
	+ Import courses & labs from B.S. and graduate study at URI	<b>95 ... 90</b>
		<b>180</b>



## Requirements for TU Braunschweig Students for M.S. at URI

- 9<sup>th</sup> semester is counted equivalent to B.S. degree plus 1<sup>st</sup> year of grad studies
- M.S. thesis option with a total of 30 credits
- 21 ... 24 course credits + 9 ... 6 credits for master thesis

Study Element	Requirements	$\Sigma$ US-credits at URI
• Courses	15 credits, corresp. to 5 courses covering 2 out of 3 core areas, e.g. for ME - fluid mechanics/thermal sciences - solid mechanics - mechanical systems	15
• Master thesis	Written report & thesis defense in English	9
<b>Total</b>		<b>24</b>
+ Import courses & labs from Diploma study at TU Braunschweig		6
		<b>30</b>

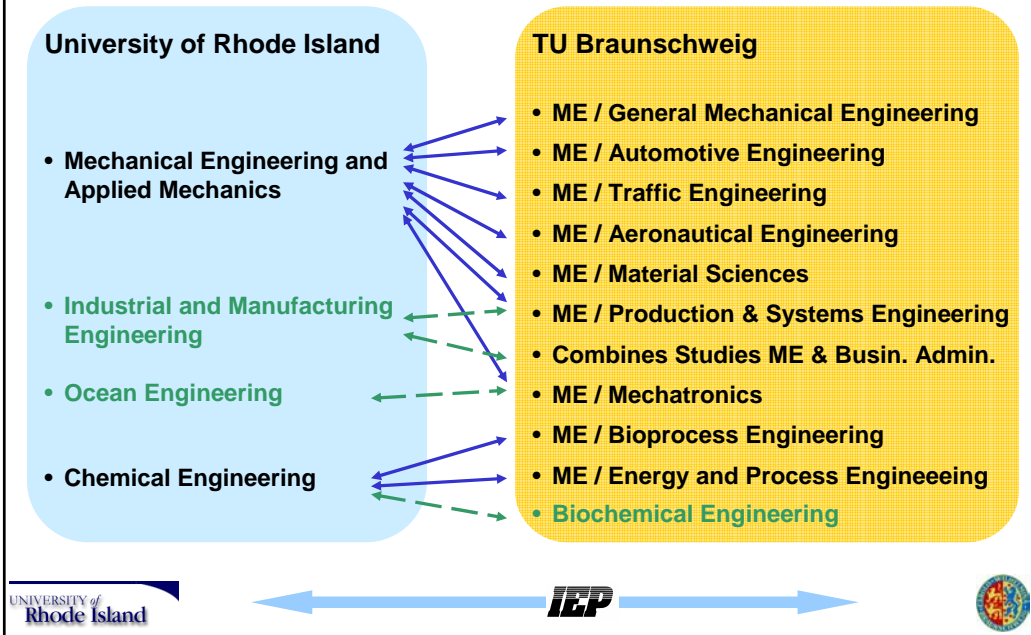


## How is it Done in Detail?

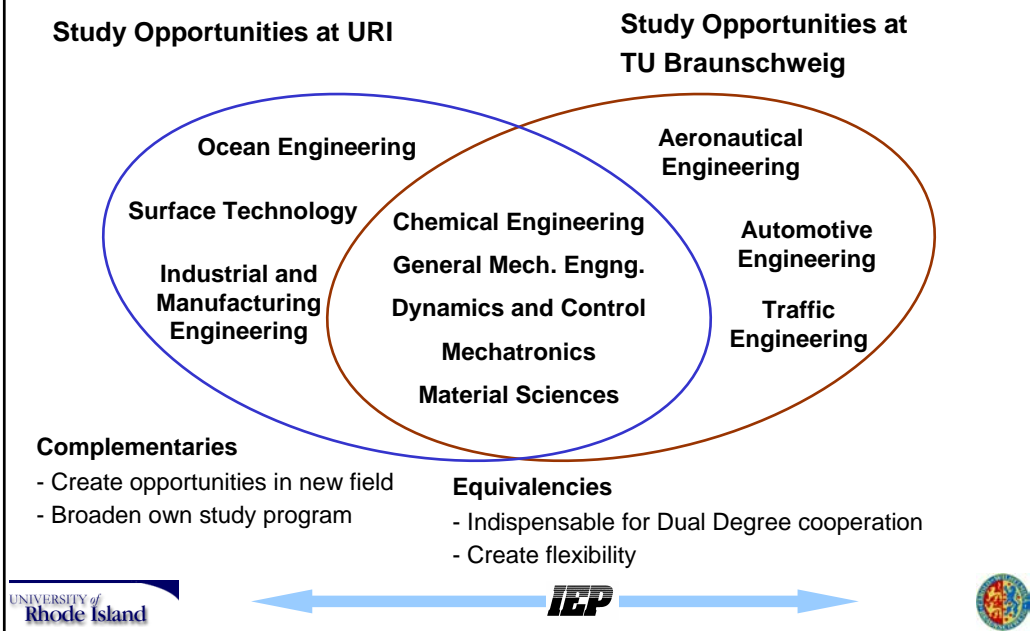
- Students prepare *Plan of Study* that equally satisfies for M.S. at URI & Dipl.-Ing. at TU Braunschweig
- Plan of Study gets preliminary approval from both institutions prior to leave of home university
- *Exchange Plan* specifies equivalencies for imported courses
- Master or Diploma Thesis, resp. is written at host institution and imported to home university
- Students graduate upon return to home university



## URI - TU Braunschweig Dual Degree Options



## Balancing Equivalencies and Complementaries



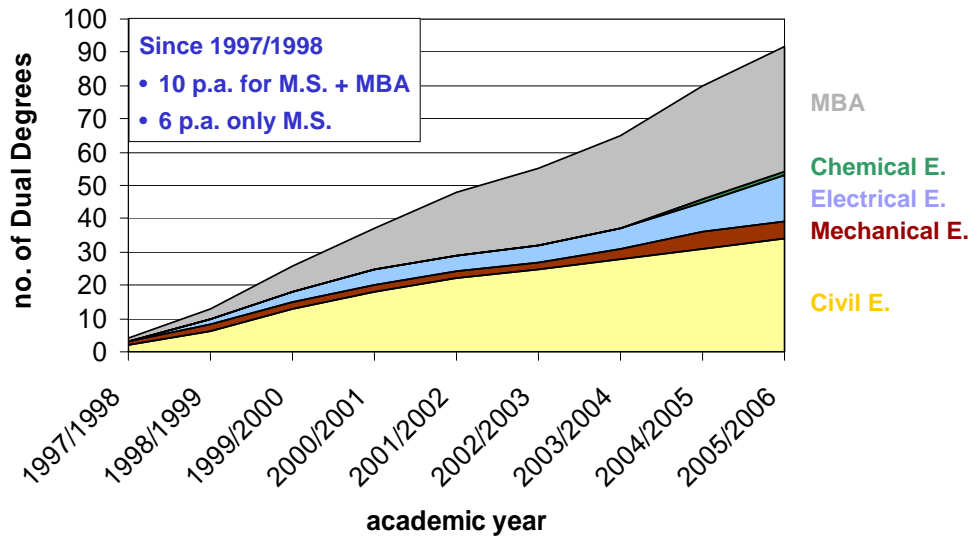
### Exchange Statistics for all Programs: IEP, Non Deg., Dual Deg.

	URI to TU BS	TU BS to URI
1995 - 1996	5	5
1996 - 1997	9	9
1997 - 1998	13	12
1998 - 1999	14	12
1999 - 2000	15	16
2000 - 2001	13	14
2001 - 2002	20	24
2002 - 2003	15	15
2003 - 2004	21	15
2004 - 2005	21	16
2005 - 2006	12	14
2006 - 2007	22	14
<b>Total:</b>	<b>180</b>	<b>166</b>

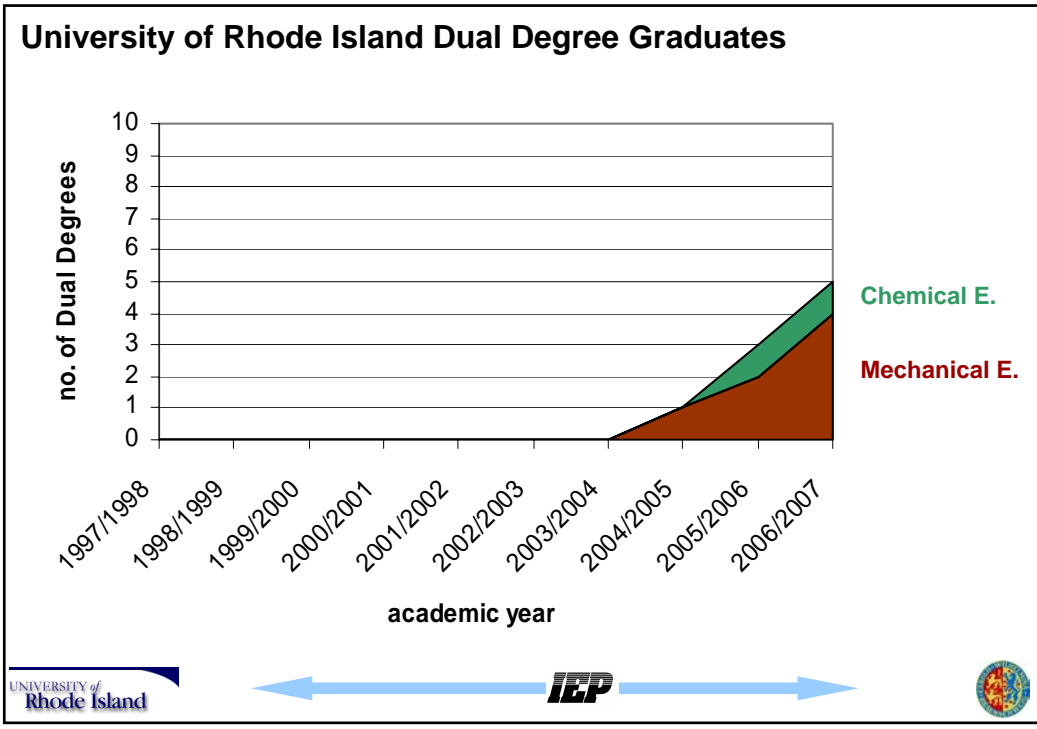
Total # of Students Exchanged: 346 ⇒ Ø 29 students p.a.



### TU Braunschweig Dual Degree Graduates







- ### Institutions and Programs Involved on Both Sides
- | University of Rhode Island   | TU Braunschweig  |
|--|--|
| <p><b>College of Engineering</b></p> <ul style="list-style-type: none"> <li>- Dept. of Chemical Engineering</li> <li>- Dept. of Civil and Environmental Engineering</li> <li>- Dept. of Electrical and Computer Engineering</li> <li>- Dept. of Industrial and Manufacturing Engineering</li> <li>- Dept. of Mechanical Engineering and Applied Mechanics</li> <li>- Dept. of Ocean Engineering</li> <li>- Graduate School of Engineering</li> </ul> | <p><b>Dept. of Electrical Engineering</b></p> <p><b>Dept. of Civil Engineering, Architecture and Environmental Sciences</b></p> <p><b>Dept. of Mechanical Engineering</b></p> <p><b>Dept. of Business and Social Sciences</b></p> <p><b>Language Center</b></p> <p><b>International Office</b></p> |
| <p><b>International Engineering Program</b></p>  |  |
- ←
**IEP**
→

## What has worked for us?

- ❖ Equally value both systems
- ❖ Pick the right partner university & strategy
- ❖ *Exchange* programs are a two-sided story: No single-sided love!
- ❖ Involve the right people: Students, faculty, administration
- ❖ Create opportunities for face-to-face faculty meetings
- ❖ Support and enforce immersion into host university system, student and social life
- ❖ Establish incentive and mechanisms to import credits earned abroad
- ❖ Find a good balance of equivalent and complementary study & program elements
- ❖ Set up confirmed study plan *before* students leave home university
- ❖ Be generous and flexible
- ❖ Clearly distinguish curriculum from financial aspects – and address both properly
- ❖ Find support by University executives



## Future Activities

- ❖ Open for new disciplines
- ❖ Faculty exchange for teaching & research
- ❖ Joint compact courses and summer programs
- ❖ Transfer into Bologna scheme at TU Braunschweig
- ❖ Bilateral and cross-disciplinary research collaboration

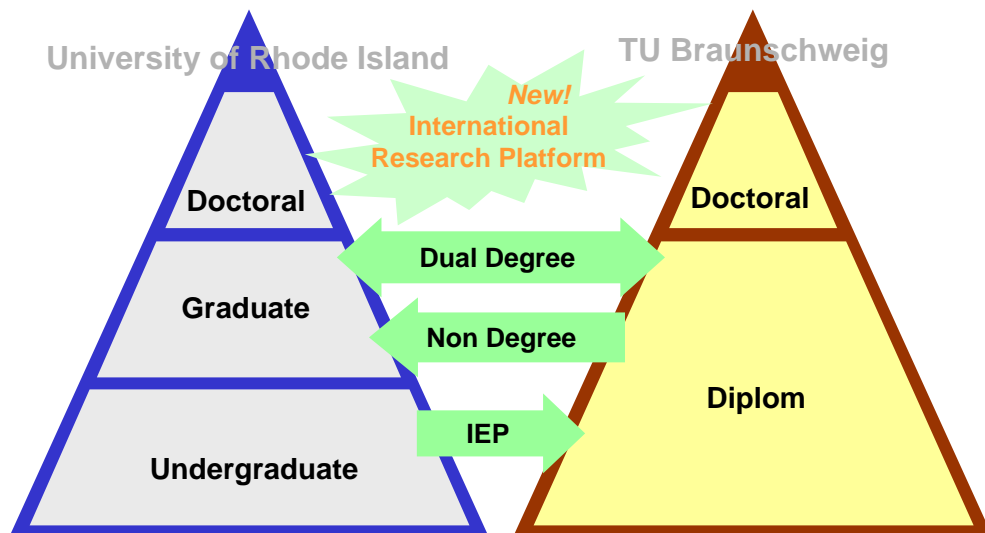


## Partnership for International Research and Education in Microfluidic Technology PIRE

- Five year NSF grant to URI
- Multidisciplinary and multinational research team model to internationalize integrated engineering education and research
- Developing novel streaming-based microfluidic technology for diverse practical applications, like „Lab-on-Chip“ for infection biomarkers
- Graduate & doctoral students as well as researchers across various disciplines on both sides (Molecular Biology, Entomology, Biochemistry, Mechanical, Electrical and Chemical Engineering)
- Integration into students final Diploma or Master project, resp., as well as research activities on both partners sides
- Costs covered for travel and project expenses on US side  
⇒ TU Braunschweig to apply for corresponding funding



## Collaboration in All Phases of Academic Education





## Importing Credits Through Special Project

### Project Summary

March 10, 2005

**International Engineering Program**  
University of Rhode Island  
and  
Technische Universität Carolo-Wilhelmina zu Braunschweig

**Special Project**

**Student:** Meghan Bellows  
IEP/Chemical Engineering at URI

**Topic:** Surface Roughness Effects on Surface Energy

In many processes in the chemical, petrochemical, food and pharmaceutical industry wetting of solid surfaces plays a prominent role. The desired characteristic wetting behavior ranges from an almost complete wetting of the surface by the liquid to complete repulsion between surface and liquid. Therefore corresponding contact angles vary from 0° to 180°. At the Institute for Chemical and Thermal Process Engineering at TU Braunschweig finding of best transfer surfaces resulting from the combination of solids is investigated. Surface energy determined from contact angle measurements is used as a primary parameter to characterize dispersion tendency of crystals.

Surface roughness exerts a major influence on the interaction between substrate and liquid. Different interaction conditions occur for wetting and de-wetting as the liquid has wetted the flanks of the surface roughness after a first full contact. This results in a hysteresis effect depending on the direction of the process.

For two different substrates, stainless steel and copper, the relation between surface roughness and surface energy was investigated experimentally. Surface roughness was changed through mechanical treatment. Also two different types of coatings on stainless steel, SiO<sub>2</sub> and C<sub>60</sub> (diamond like Carbon), were characterized with respect to surface energy and roughness. A Profilometer and an Atomic Force Microscope (AFM) were used to determine surface roughness. These techniques cover different surface areas, some cm<sup>2</sup> with the Profilometer vs. 100 µm x 100 µm for the AFM. A Drop Shape Analyser (DSA) was used to measure the contact angle and from this calculate surface energy using two different approaches: acid-base model and CVM<sub>2</sub> method.

Content and main results of the project are presented in a written report as well as in an oral presentation in German.


**Duration, Workload:** The project was completed between Nov. 23, 2004 and Feb. 11, 2005 with a total workload of 43 h.

**Research Assistant:** Timo Gockert  
ICTV, Tel. +49 (0)51 391 2794, E-Mail [Gockert@tu-braunschweig.de](mailto:Gockert@tu-braunschweig.de)

**Prof. Dr. Otto Gregory:**  
Distinguished Engng. Professor of Chem. Engng.  
University of Rhode Island

**Prof. Dr.-Ing. Stephan Schell:**  
Institut für Chemie und Thermische  
Verfahrenstechnik, TU Braunschweig

### Attestation with Grade & Workload

  
March 10, 2005

**Attestation**

Mrs. Meghan Bellows  
University of Rhode Island  
IEP / Chemical Engineering

has concluded a special project on

"Surface Roughness Effects on Surface Energy"



at the Institut für Chemie und Thermische Verfahrenstechnik (Institute for Chemical and Thermal Process Engineering). The project comprised of experimental work, a written report and an oral presentation, both in German language.

The project was conducted between Nov. 23, 2004 and Feb. 11, 2005 with a total workload of 43 hours.

**Grade received:** 1.0 (A)

*Stephan Schell*

Prof. Dr.-Ing. Stephan Schell

## Braunschweig Non Degree-Students The Dual Degree Program

- Outlines were established in 1997: Adaption to new Diploma Degree Regulations of 2003 in ME Dept. of TU Braunschweig
- Open possibility and ease administration for students in other Graduate Programs
  - URI: Chemical Engineering, Manufacturing Engineering, Ocean Engineering
  - TU BS: Combined Studies of Business Administration & Mechanical Engineering
  - Synchronize course schedule & identify equivalencies
- Integrate additional elements of collaboration
  - Compact Summer Courses
  - International Summer Semester Program
- Dual Degree statistics since 1997/98: Dipl.-Ing. TU BS and M.S. URI
  - M.S. for TU BS students at URI: MCE 5, CHE 1, CVE 31, ELE 9
  - Dipl.-Ing. for URI students at TU BS:
    - 1st in 2004/05 -> Eric Sargent: Automotive Engineering

