Projects and Products Portal for Leonardo da Vinci

Virtual Performance Centred Environment for Training in Nanoelectronics

FR/06/B/P/PP-152507

http://www.adam-europe.eu/adam/project/view.htm?prj=7452

Project Information

Title: Virtual Performance Centred Environment for Training in Nanoelectronics

Project Number: FR/06/B/P/PP-152507

Year: 2006

Project Type: Pilot Project, project with multiplying effect (2000-2006)

Status: completed

Country: FR-France

Marketing Text: The multidisciplinary science of nanoelectronics is just emerging. There is a need of re-training of personnel in the enterprises and education of young specialists for the sector and a collaborative development approach will provide the most effective training.
The purpose of Train_Nanoelectronics project was to foster synergy and to exchange experience and resources of developers and users of vocational education in high-tec through development of distributed curricula in the newly emerged interdisciplinary sector of nanoelectronics. The Internet-based courses developed within the Train_Nanoelectronics project provide new opportunities for co-operation between vocational training institutions, universities and SMEs in the sharing of knowledge and educational resources: a distributed support system in four European countries was created.

Summary: The multidisciplinary science of nanoelectronics is just emerging. There is a need of re-training of personnel in the enterprises and education of young specialists for the sector and a collaborative development approach provides the most effective training.
The Train_Nanoelectronics project is aimed at the design, development, evaluation and implementation of a Virtual Performance Centred Environment for Training in Nanoelectronics. Its specific objectives are:
- Development of a virtual performance-centred environment for university and vocational education in nanoelectronics with tools for groupwork and a knowledge base.
- Design and development of distributed curricula in nanoelectronics technology, design and packaging.
- Development of an on-line performance support system for course developers.
- Training the core user groups of training providers– educational policy makers, teachers and managers in the innovative learning approaches and in the effective collaborative use of new technologies in education.

Description: Whether used to enhance traditional classroom teaching or for distance education, the Internet has forever transformed the way we teach, learn, and transfer knowledge in the digital age. Policy makers, educational managers, teachers and tutors training is related to the efficient support system set up and to the new way of curricula development and implementation.
Train_Nanoelectronics project is a continuing work, based on an existing model, developed working prototype, conducted empirical research and analysis of experimental data that have been done in a previous project – Internet-based Performance Centred Instruction – the Link between Work and Education (IPCI F/02/B/P/PP-118074). In the Train_Nanoelectronics the added value is:
- re-design of the learning environment to a virtual one with a distributed data base on the servers in different countries,
- development of software tools for online collaborative learning and project design, i.e. for distributed learning and eWork,
- development of a performance support system for on-line course development,
- distributed curricula are developed, i.e. the courses are developed in a co-operative mode. Each part of the curriculum is designed by the best laboratory in the field, e.g. French partners are best in the design and they will work on the nanoelectronics design, the Netherlands partners – in technology etc.
- database to facilitate access to training and professional realisation of women in the sector of micro- and nanoelectronics and to provide equal opportunities for women and men,
- and last but most important added value is that courses in the new multidisciplinary

Project Information

science were developed - in nanoelectronics.

Themes: *** Lifelong learning
*** Open and distance learning
** Enterprise, SME
** Continuous training
* Labor market
* Higher education

Sectors: *** Professional, Scientific and Technical Activities
** Manufacturing
* Education

Product Types: material for open learning
open and distance learning
website
CD-ROM

Product information: The main project outcomes are:
- Virtual performance-centred environment for university and vocational education in the most rapidly developing science: nanoelectronics (Train_Nanoelectronics environment).
- Distributed curricula in nanoelectronics technology, design and packaging with six training courses:
- Carbon Nano Tubes,
- Scanning Tunneling Microscopy,
- Nanoelectronics Packaging,
- Scanning Force Microscopy,
- RAMAN.
- Network of tutors/coaches in the partners' institutions. It is a distributed system for learner coaching from subject matter experts/professionals in nanoelectronics in four European countries.
- On-line performance support system for course developers.
- Database to facilitate access to training and professional realisation of women in the sector of micro- and nanoelectronics and to provide equal opportunities for women and men.

Projecthomepage: http://dipseilpc.cime.inpg.fr/nano/

Project Contractor

Name:	Institut national polytechnique de Grenoble
City:	Grenoble
Country/Region:	Rhône-Alpes
Country:	FR-France
Organization Type:	university/Fachhochschule/academy
Homepage:	http://www.grenoble-inp.fr

Contact Person

Name:	Philippe Morey_Chaisemartin
Address:	
City:	
Country:	FR-France
Telephone:	
Fax:	
E-mail:	philippe.morey@phelma.grenoble-inp.fr
Homepage:	

Coordinator

Name:	Institut national polytechnique de Grenoble
City:	Grenoble
Country/Region:	Rhône-Alpes
Country:	FR-France
Organization Type:	university/Fachhochschule/academy
Homepage:	http://www.grenoble-inp.fr

Contact Person

Name:	Philippe Morey_Chaisemartin
Address:	
City:	
Country:	FR-France
Telephone:	
Fax:	
E-mail:	philippe.morey@phelma.grenoble-inp.fr
Homepage:	

Partner

Partner 1

Name: Masho
City: Sofia
Country/Region: Yugozapaden
Country: BG-Bulgaria
Organization Type: SME - small and medium-sized enterprise (up to 250 employees)
Homepage:

Partner 2

Name: XYALIS
City: Grenoble
Country/Region: Rhône-Alpes
Country: FR-France
Organization Type: SME - small and medium-sized enterprise (up to 250 employees)
Homepage: http://www.xyalis.com

Partner 3

Name: Technical University of Sofia
City: Sofia
Country/Region: Yugozapaden
Country: BG-Bulgaria
Organization Type: university/Fachhochschule/academy
Homepage: http://tu-sofia.bg

Partner 4

Name: SITELESC
City: Paris
Country/Region: Ile De France
Country: FR-France
Organization Type: trade union organisation
Homepage: http://www.sitelesc.fr/

Partner

Partner 5

Name:	GREX / Euro Info Centre Grenoble
City:	Grenoble
Country/Region:	Rhône-Alpes
Country:	FR-France
Organization Type:	chamber
Homepage:	http://www.grex.fr/

Partner 6

Name:	eWorks GmbH
City:	Frankfurt am Main
Country/Region:	Hessen
Country:	DE-Germany
Organization Type:	SME - small and medium-sized enterprise (up to 250 employees)
Homepage:	http://www.eworks.de/

Partner 7

Name:	Universiteit Twente
City:	Enschede
Country/Region:	Oost-Nederland
Country:	NL-Netherlands
Organization Type:	university/Fachhochschule/academy
Homepage:	http://www.utwente.nl/

Products

1 Course "Carbon Nano Tubes"

2 Course "Scanning Tunneling Microscopy"

3 Course "Nanoelectronics Packaging"

4 Course "Nanoelectronics"

5 Courses "Scanning Force Microscopy"

6 Course " RAMAN"

Product 'Course "Carbon Nano Tubes"'

Title:	Course "Carbon Nano Tubes"
Product Type:	material for open learning
Marketing Text:	Carbon nanotubes and nanocomposites show amazing electric and mechanic properties which make them predestined to contribute to the creation of totally new products. They play a decisive role in the development of future engineering materials and new micro and nanoelectronic devices. The modules on carbon nanotubes give an introduction and overview on the basic physical and electronic properties of carbon nanotubes, various methods of synthesis, and characterization in view of desired applications in research and development of nanotube based products, such as cold cathode electron emitters and nanoelectronic devices.
Description:	Contents: - Structure and Properties of Carbon Nanotubes - chirality and electronic structure - Synthesis of Carbon Nanotubes - Arc discharge, Laser ablation, Chemical vapour deposition (CVD) - Examples of CNT applications in micro- and nanoelectronics - CNTs as electron sources (cold cathode emitters), CNTs for electronic circuits. Estimated duration: about 3 x 90 minutes online studies, including exercises
Target group:	Engineers working in the field of electrical engineering, industrial engineering, material science or related fields, master students and PhD students in the fields of electrical engineering, micro & nanotechnology, microelectronics, material science or related topics.
Result:	tested and implemented
Area of application:	training organisations, universities, SMEs in micro- nanoelectronics
Homepage:	http://dipseilpc.cime.inpg.fr/nano/courses/courseNanoTubes.php
Product Languages:	English

Product 'Course "Scanning Tunneling Microscopy"'

Title: Course "Scanning Tunneling Microscopy"

Product Type: material for open learning

Marketing Text: Scanning Tunneling Microscopy (STM), developed in 1981 by Binnig and Rohrer at IBM Rüschlikon, is one of the most fascinating technological innovations as it allows to discover the ‘nanoworld’ on an atomic scale. Many of the scientific results show technological impact in the field of nanotechnology for example in the developments of new electronic devices used in the field of micro- and nanoelectronics, such as e.g. thin film transistors for chemical or biosensors. The module STM aims to give an introduction to the powerful characterization tools offered by this scanning probe microscopy method. Aside the underlying physical concepts, the measurement principle, and STM instrumentation, the module focuses on STM applications in surface analysis and the topographic and electronic characterization of nanoscale components, as well as on scientific research examples oriented towards molecular electronics.

Description: Contents:
- Introduction to scanning tunneling microscopy
Measurement principles, theoretical description of quantum mechanical tunneling (including exercises), tunnel barrier, tunneling current (tunneling regime and field emission regime), atomic resolution of monatomic steps, lateral atomic resolution, history of technical developments, some examples on modern applications
- Methods of tip and sample preparation
tip materials, preparation methods, examples of sample materials and their methods of preparations in air and in ultrahigh vacuum (UHV)
- STM tip-positioning
Technical requirements for tip-positioning, inverse piezoelectric effect, short overview over piezoelectric materials, hysteresis of piezos, references to electronic circuits for piezos
- Signal detection and feedback-loop
Detection of tunnel current, references to electronic circuits for tunnel current amplifiers, low noise I-U converters, feedback loop, role of the gain
- Common artifacts:
the role of the tip, typical artifacts in images with “bad tips”, artifacts due to piezo hysteresis
- Scanning tunneling spectroscopy, electronic structure and STM data interpretation
Chemical imaging, spectroscopic modes in STM: measurement principle, technical requirements, advantages/disadvantages of different spectroscopic modes and the information gained: knowledge about electronic structure => examples for data interpretation in case of semiconductors, ultrathin insulators, adsorbed molecules, supraconductors, ...
- Applications of STM in the fields of micro and nanoelectronics and from research towards molecular electronics
selected topics
Estimated duration: about 5 x 90 minutes online studies, including exercises

Target group: Engineers working in the field of electrical engineering, industrial engineering, material science or related fields, master students and PhD students in the fields of electrical engineering, micro & nanotechnology, microelectronics, material science or related topics.

Result: tested and implemented

Area of application: training organisations, universities, SMEs in micro- nanoelectronics

Homepage: http://dipseilpc.cime.inpg.fr/nano/courses/courseStm.php

Product Languages: English

Product 'Course "Nanoelectronics Packaging"'

Title: Course "Nanoelectronics Packaging"

Product Type: material for open learning

Marketing Text: The course covers the research and innovation in the following major topics:
- electronic packaging;
- application specific MEMS/NEMS packaging and panel;
- critical issues in accelerated life testing and field reliability;
- high density interconnects and 3-D packaging;
- influence of stresses and defects on nanoelectronics/MEMS performance;
- lead-free solders;
- mechanical reliability;
- micro and nano scale heat transfer in electronics; cooling of microelectronics;
- reliability issues in nanoelectronics/ nanoelectromechanical packaging

Description: Objective:
The learners will be able to define the most convenient packaging solution for different applications, evaluate the reliability, identify possible defaults in packages to assure the quality and reliability.

Prerequisite Knowledge
It is assumed that learners are familiar with the theoretical basis of electronic components and circuits construction and functioning, treated in the courses on
-“Semiconductor Devices”
-“Theory of Electronic Circuits”
-“Digital Circuits Design”
-“MCMs, Assembling and SMT”
-“Electronic Measurements”

Estimated duration of the course: 50 hours

Target group: - A distinction can be made between company employees following some modules or the whole course as part of their professional development, and university students for which the course will be a part of their regular electronics curriculum.
- Students last semester (8th) bachelor degree in microelectronics and power electronics – elective course

Result: tested and implemented

Area of application:

Homepage: http://dipseilpc.cime.inpg.fr/nano/courses/coursePackaging.php

Product Languages: English

Product 'Course "Nanoelectronics"'

Title: Course "Nanoelectronics"

Product Type: material for open learning

Marketing Text: Content
- Elementary quantum-mechanics
- Conducting properties of materials
- Devices: barrier as fundamental principle
- Single-electron devices
- Quantum dots
- Kondo effect
- Organic electronics
- Basics of magnetism
- Nano-magnetism
- Spin-dependent transport
- Spin-dependent tunneling, MRAM

Description: Objectives:

Users should get a sound understanding of various topics in nano-electronics with a special focus on spintronics. The course starts with an introduction discussing the basic physics required to understand nano-electronic device concepts as well as conventional silicon based devices. Different aspects of nano-electronics will be further elaborated on, covering single-electron and organic electronics. The topic of spintronics will be discussed in more detail.

Prerequisites

A good understanding of high-school physics is required, as well as some fundamental course in electronics engineering explaining band structures.

Estimated time needed for completing the course
The material represents 20-24 lecture hours. For completing all parts this will require approximately 6 weeks.

Target group: The course is open to a broad audience interested in nano-electronics. It can be students in electrical engineering or applied physics, as well as professionals who want to get a grip on the topic.

Result: tested and implemented

Area of application: training organisations, universities, SMEs in micro- nanoelectronics

Homepage: http://dipseilpc.cime.inpg.fr/nano/courses/courseNanoelectronics.php

Product Languages: English

Product 'Courses "Scanning Force Microscopy"'

Title: Courses "Scanning Force Microscopy"

Product Type: open and distance learning

Marketing Text: The course covers the research and innovation in the following major topics:
- Tip-sample interaction at the nanometer scale according to the working environment
- Surface and object characterization by SFM : potential and limitation
- Electrical characterization of thin oxide film and nanoelectronics structures
- SFM probe use as a nanotool to elaborate or modify nanodevices.

Description: Objective: The learner will be able to: (1) Select the right scanning force microscopy technique according to the sample specificities and nature and to choose the working mode in function of the characterisation needs; (2) Treat and analyse the SPM data in order to identify the most relevant information and to avoid common artefacts; (3) Inject and/or detect electrical charge in thin oxide film or nanostructure used in nanoeletronics; (4) Use the probe as a nanotool; (5) Follow a practical lab training course on SFM(as e.g. regularly provided by Grenoble university in the Nanoworld platform.

Target group: Technicians and Engineers working in the field of electrical engineering, industrial engineering, material science or related fields, master students and PhD students in the fields of electrical engineering, micro & nanotechnology, microelectronics, material science or related topics.

Prerequisite Knowledge

Basic knowledge in solid state physics, Newton’s mechanics, electrical engineering, and material science (Bachelor level or practical working experience).

Estimated duration of the course: about 5x 90 minutes online studies, including exercises

Result: tested and implemented

Area of application: training organisations, universities, SMEs in micro- nanoelectronics

Homepage: http://dipseilpc.cime.inpg.fr/nano/courses/courseSfm.php

Product Languages: English

Product 'Course " RAMAN"'

Title:	Course " RAMAN"
Product Type:	material for open learning
Marketing Text:	The course covers the research and innovation in the following major topics: - fundamentals of Raman scattering in solids - specificities of Raman studies at the nanometer scale. - composition and strain cartography in semiconductors structures - thin and ultrathin layer studies - carbon nanotube and quantum dots imaging
Description:	Objective: The trainees will be able to : (1) understand the fundamentals of Raman scattering in solids. (2) set up an experiment specific to the studied object (3) treat and analyse Raman spectra ; (4) propose specific solutions for the studies of nanoobjects. Prerequisite Knowledge Basic knowledge in solid state physics and optics. Estimated duration of the course: about 50 hours including studies, exercises and tests
Target group:	Master students and PhD students in the fields of micro & nanotechnology, material science, optics, instrumentation or related topics Technicians and Engineers working in the field of electrical engineering, industrial engineering, material science, micro & nanotechnology or related fields.
Result:	tested and implemented
Area of application:	training organisations, universities, SMEs in micro- nanoelectronics
Homepage:	http://dipseilpc.cime.inpg.fr/nano/courses/courseRaman.php
Product Languages:	English