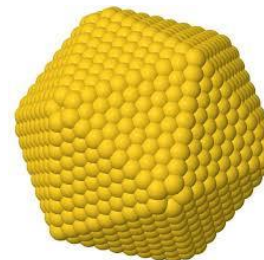
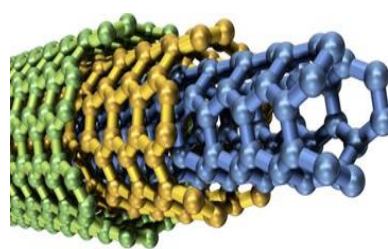
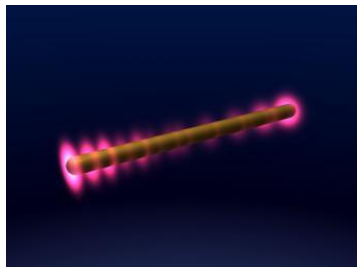
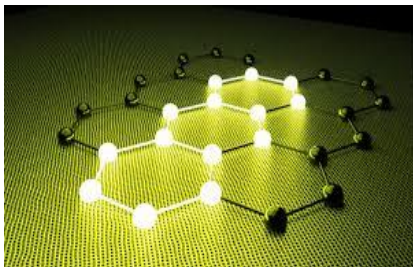


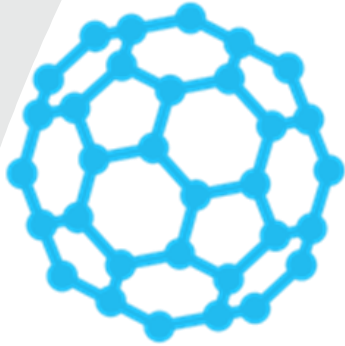
Research centers on Nano inside Institute AMUTech

Pierre Müller

Professor Aix Marseille University

Director of CINaM
Director of AMUTech





Institut
Matériaux Avancés
et Nanotechnologies
Aix*Marseille Université

Institute for Advanced Materials and Nanotechnology

Creation in january 2021

Contact: amutech-direction@univ-amu.fr

Key objective :

Exalting specific properties at the nanoscale to develop new materials/devices at the meso and macroscopic scales.

Triptych : «**Understand, fabricate, Innovate**»

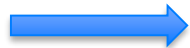
Bottom-up approach: *from fundamental aspects to applications*

**Physics and chemistry
at the nanoscale**

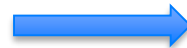
Advanced materials

Nanotechnologies

**Fundamentals
and
elementary structures**



Assembling



Devices and applications

- Increase the visibility and attractiveness (students, companies) of AMU on materials and nanosciences.
- Promote the synergy between physicists and chemists, academics and industrials.
- Define common objectives for research and training via shared platforms
- Will to work with society (Humanities and social science).

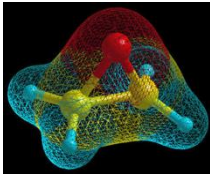
Research

**Physics and chemistry
at the nanoscale**

Advanced materials

Nanotechnologies

Fundamentals
and
elementary structures



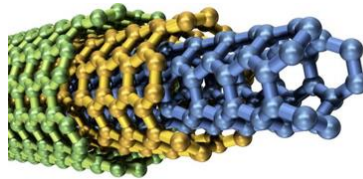
Molecular chemistry

Physics of nano-objects

Physics and chemistry
of surfaces and interfaces

Properties at the nanoscale

Assembling



Supramolecular
chemistry

Synthesis, growth, assembling,
nanostructuration

Nanomaterials

Metamaterials,
Functionnal materials

Devices and applications



Organic and molecular
electronics

Emerging devices

Nanoelectronics

Nanophotonics

Common research platforms and facilities

Domains and fields of innovation:
Energy, Health, Transport, Communication, Environment, Security and defence

AMUtech gathers 9 laboratories



*Interdisciplinary Center of
Nanoscience of Marseille*



*Institute of Materials Microelectronics
and Nanotechnology of Provence*



Institute of Radical Chemistry



*Institute of Molecular
Sciences of Marseille*



Fresnel Institute



*Divided Materials, Interfaces,
Reactivity, Electrochemistry*



Centre de Physique Théorique

Center for Theoretical Physics



*Lasers, Plasmas and
Photonic Processes Laboratory*



*Laboratory of Physics of Ionic
and Molecular Interactions*

Roughly more than 700 people are working in this domain inside these labs
(the total number of searchers in these lab is greater)

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Short presentation of the activities on nano by the AMUtech labs



*Interdisciplinary Center of
Nanoscience of Marseille*

Physics and chemistry of nanomaterials

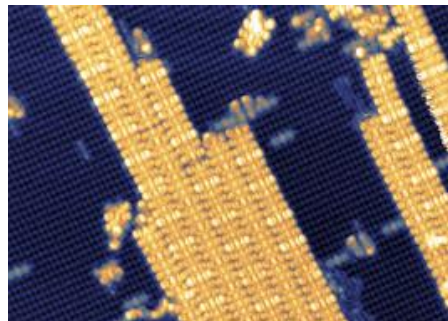
Conception, elaboration, analysis
Surfaces/Interfaces
Nano-objects
Phenomena at the nanoscale
Local field and local probes



*Institute of Materials Microelectronics and
Nanotechnology of Provence*

Physics at the nanoscale

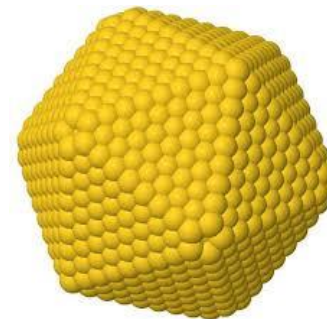
Functional nanostructures & nano-components
Structure & chemistry of materials
Detection, radiation and reliability
Analysis & design of electronic systems



Institute of Radical Chemistry

Explore, control and use the reactivity of radical species.

Nanostructured organics materials
Reinforced composite materials
Nanoparticles nanotoxicity

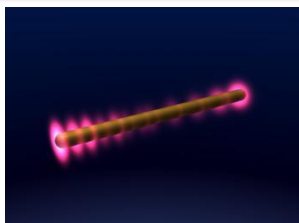


Short presentation of the activities on nano by the AMUtech lab



Nanophotonics and components

Nanophotonics, nanoplasmonics, opt antenna
Theory and simulation
Thin film and nanostructuration by Laser
Metamaterials and metasurfaces



*Institute of Molecular
Sciences of Marseille*

Chemical modelling and mechanisms

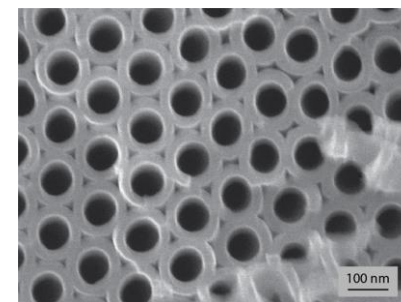
Surface functionalization
Supramolecular assemblies
Organic lithography
Nanographene
Polyarom. analog
Smart materials



*Divided Materials, Interfaces,
Reactivity, Electrochemistry*

Nanoporous materials for applications

energy, health and the environment:
adsorbents, microbatteries, membranes,
sensors, energy storage, etc.



Short presentation of the activities on nano by the AMUtech labs



Centre de Physique Théorique

Center for Theoretical Physics

Theory of quantum transport



*Laboratory of Physics of Ionic
and Molecular Interactions*

**Gaz, plasmas, ions, atoms, molecules and their
interaction with matter**

2D materials;

Artificial 2D topological materials (Xenes)

Functionalization of adsorbed molecules

Electronic and vibrational spectroscopies



*Lasers, Plasmas and
Photonic Processes Laboratory*

**Laser-matter interaction in short and ultra-
short pulse mode**

Nanoparticles for theranostics

Laser techniques for bioprinting

3D silicon and dielectric laser writing

Laser-based technique for (sub)- μm
surface structuration



Many technological facilities are associated to these labs

ASUR: Laser applications (LP3)

CP2M: Electronic Microscopy (Chem. Fed.)
2 SEM, 1 FIB, 2 TEM

Espace photonique: Thin films for optics (Fresnel)
Plasma sputtering, ions pulverisation, spectrophotometer...

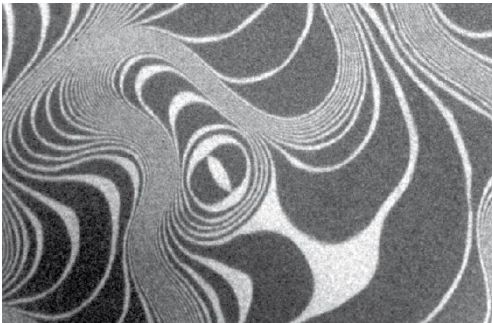
NanoTecMat : Epitaxy Si, Ge (IM2NP)
Lithography, RIE, Epitaxy, spectroscopies, FIB...

Planete: Clean room for nanofabrication (CINaM)
Lithography , deposition magnetron sputtering, reactive ion etching...

RPE platform : Electron spin resonance (Chem. Fed.)

Spectropole : Nuclear Magnetic Resonance, Mass spectrometry (Chem. Fed.)

.



Completed by several very specific equipments

Atomic probe tomography (IM2NP)

Low Energy Electron Microscopy (CINaM)

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Call for projects of AMUtech (for research and training) will focus on two axes, four themes, 17 key words

	Smart Materials	Optronics
Energy conversion and storage	<i>Capacitors</i> <i>Batteries,</i> <i>PhotoVoltaics</i>	<i>Nanorectena</i>
Functionality and adaptation	<i>Modified graphene,</i> <i>2D Covalent networks</i>	<i>Meta surfaces</i> <i>Meta materials</i>
Detection	<i>Photochemistry</i> <i>Sensitive chemistry</i>	<i>Nanostructured surfaces</i> <i>Plasmonics</i>
Heterogenous integration	<i>2D Stacking</i> <i>Hybridous Semi conductors</i> <i>Flexible electronics</i>	<i>Electron/photon coupling</i> <i>Nanophotonics</i>

An attempt to give a (partial) overview (by studied objects)

	CINaM	IM2NP	ICR	ISM2	Fresnel	Madirel	LP3	PIIM	CPT
Surfaces/interfaces	Dynamic of surf. Fonctionnalization Nanostructuration	Structure Fonctionnalization Nanostructuration	Function nalization	Functionna lization			Structura tion	Function alization	
Ultrathin films	Ferroic spintronics	Ferroic Spintronic			Thin films for optics	Menbr.	Thin films for optics		
2D materials	Graphene, Silicene MoS2,	Graphene		Nanograph Polyaroma tics analog.				X'enes	
Nanoparticles	Catalysis Theranostic Natural NP	Quantum dots			Nanoplas monics		Nanoplas monics Therano.	Stellar dusts	
Nanowires, Nanotubes	C, Si....	C, Si, Ge...				TiO ₂ ...			Quant. Transp.
Nanoporous, Nanocompos.	Concrete, For energy		Reinf. Compos.		Metamat	For energy, health ...			
Selfassembly	Supramol. chemi. Organic layers	Coherent 2 D polymers	Supramol . chem.	Supramol. Chem.					
Instrumentat.	Local probes	sensors			Sensors				

APPLICATIONS: Health, Energy, Environment...

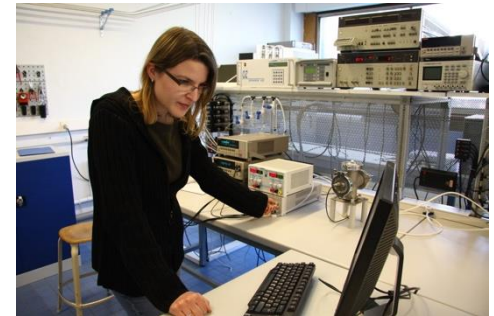
An attempt to give a (partial) overview (by studied properties)

	CINaM	IM2NP	ICR	ISM2	Fresnel	Madirel	LP3	PIIM	CPT
Phase transitions	X	X	X			X		X	
Quant. transport		X	X						X
Spintronics	X	X							
Opt. prop.	X	X			X		X		
Mech. prop.		X							
Vibr. prop.	X	X					X	X	
Therm. prop.					X	X	X		
Electron. prop.	X	X	X		X			X	
Magnetic prop.	X	X	X	X		X			X
Chem. prop.	X		X	X		X			
Reactivity	X		X	X		X		X	
Photovoltaic.	X	X			X		X		X
Simulations	X	X	X	X	X				

Training by research

Improve the content of AMU's training courses to reinforce one or all of the following points...

- Enhanced international attractiveness by specific AMUtech scholarships (incoming and outgoing)
- « **Training by research** » : Immersion of Master's students in AMUtech's interdisciplinary research environment and research internships
- **Reinforce the link between masters and phd**
- **Master class** : for international multidisciplinary training (including humanities and social science)
- « **Learning by doing** » : Easy access to technological platforms development of integrated projects
- **Fostering cooperation:** especially inside CIVIS





Thank for your attention

(in spite the difficulty of the exercise)

Contact: amutech-direction@univ-amu.fr



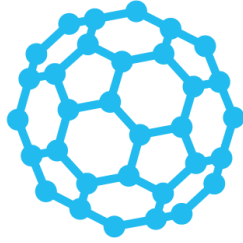
Appendix

**In these labs, only people working in the field of materials
and nanotechnologies
are concerned by AMUtech.**

	Staff	PhD and Post doc	Total
IM2NP	154	70	224
CINaM	94	80	174
ICR	85	30	115
ISM2	30	30	60
Fresnel	27	20	47
Madirel	28	15	43
CPT	8	3	11
LP3	10	4	14
PIIM	20	2	22
Total	456	264	720

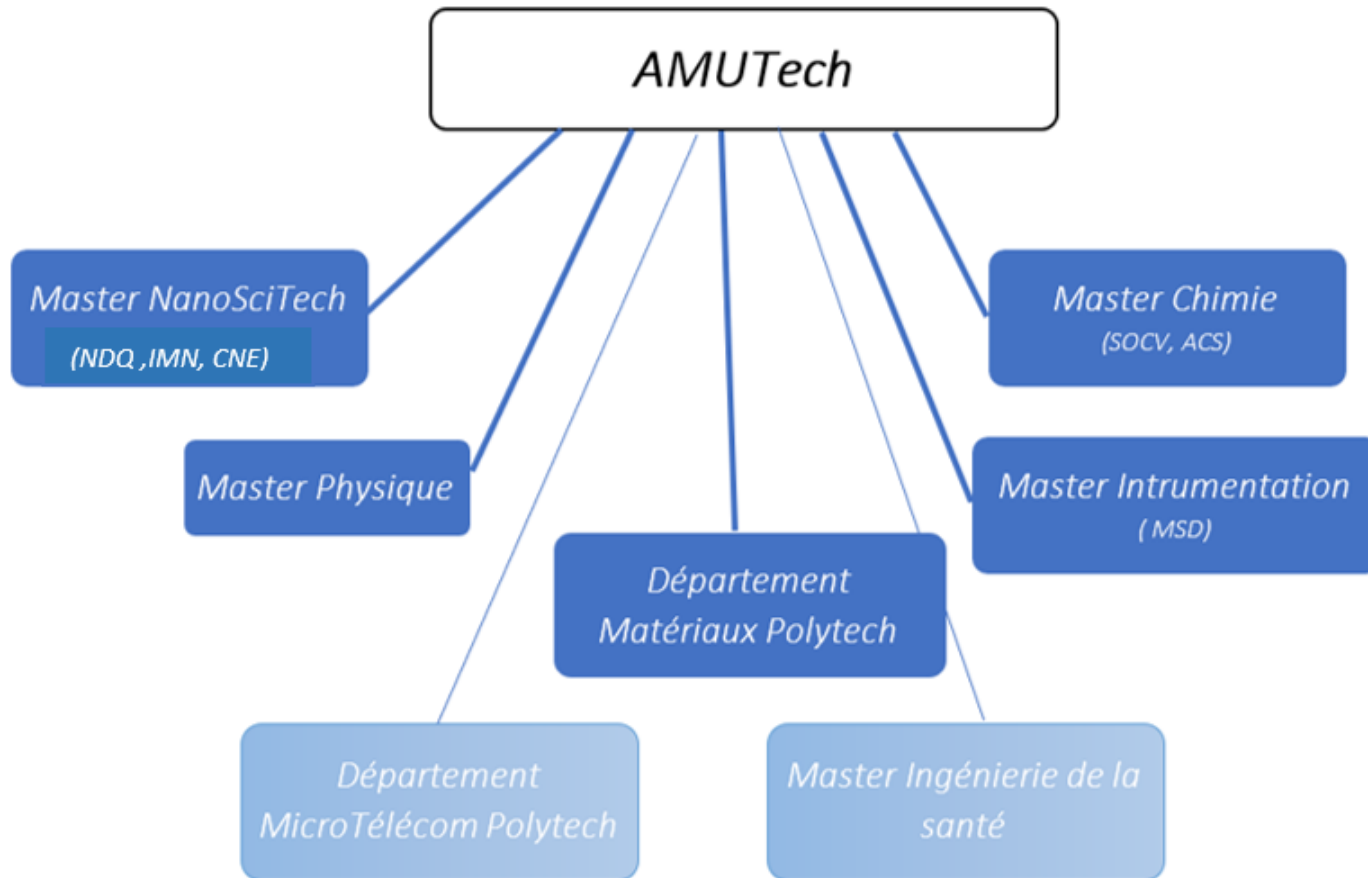
An attempt to give a (partial) overview of strengths (by key words)

	Couplage UMR	IM2NP	CINaM	ICR	IF	ISM2	MADIREL	CPT	LP3	PIIM
Super-condensateurs et micro-batteries	***	•	••	••			••			
Nanophotovoltaïque	**	••	••	•				••		
Nano-rectenna	***	••		•			•			
Graphène modifié	*	••	••			••				••
Réseaux covalents	***	••	••	••		••				•
Métasurfaces et métamatériaux	*	••	••		••	••	•		•	
Photochromes	*		••	••	••					
Chimie sensitive	*		•	••	•	••	••			
Surfaces nanostructurées	***	••	••	••	••	••	••		••	••
Nano-plasmonique	*	••	•		••				••	
Empilements 2D	**	••	••		••	••				••
Semi-conducteurs hybrides	*	••	••							
Electronique flexible	*	••	••	•	•				•	
Couplage électron-photon dans les nano-hétérostructures – Transport quantique	*	••	•	••				••		•
Nanophotonique compatible CMOS	*	••	•		••					



- Reinforcement of the visibility of the site through AMUtech's key actions in its fields of expertise
- **Increased attractiveness of the site: high level students, national and international experts, visitors**
- **Important implementation of multidisciplinary (physics, chemistry, environment, health, human and social sciences, ...)**
- Training/Research/Industry links strengthened through strategic partnerships and long-term policy
- Expected increase in the success rate for PPAs, especially European (concept of AMUtech consortium)
- Emergence of new flagship themes in teaching and research

The AMU's training courses related to AMUtech



NDQ : Nano-ingénierie et Dispositifs Quantiques
IMN : Ingénierie des Matériaux et Nanotechnologies
CNE : Chemical Nano engineering
SOCV : Synthèse Organique et Chimie Verte
ACS : Analyse Chimique et Spectroscopie
MSD : Microcapteurs et Systèmes de Détection



A new dynamic to strengthen the link between training and research

AMUTech will be created on January 2021.

Archéologie Méditerranéenne

Archimède Mathématiques Informatique

Cancer et Immunologie

Créativité et Innovations

Marseille Imaging

Marseille Maladies rares

Mécanique et Ingénierie

Méditerranéen pour la Transition Environnementale

Microbiologie, Bioénergies et Biotechnologie

NeuroMarseille

Physique de l'Univers

Sciences de la Fusion et de l'Instrumentation en Environnements Nucléaires

Sciences de la santé publique d'Aix-Marseille

Institut Sociétés en Mutation en Méditerranée



Beyond multidisciplinary

Stimulate transdisciplinarity:

Multiply the points of view

(Technological, political, european law, social, philosophical, ethical...)

Researchers: Fostering HSS and legal participation in projects

Students: Integrating SHS and laws dimensions into academic programs

Society: coffee-debate associating SHS and laws.

Towards the creation of

Center for the Study of Nanosciences and Nanotechnologies in Society