INSTITUTE OF
MATERIALS SCIENCE
AND COMPUTING

NANOMATERIALS LAB-FLAME SPRAY PYROLYSIS

University of Ioannina-Department of Physics

Section of Solid State Physics and Physics of Materials and Surfaces

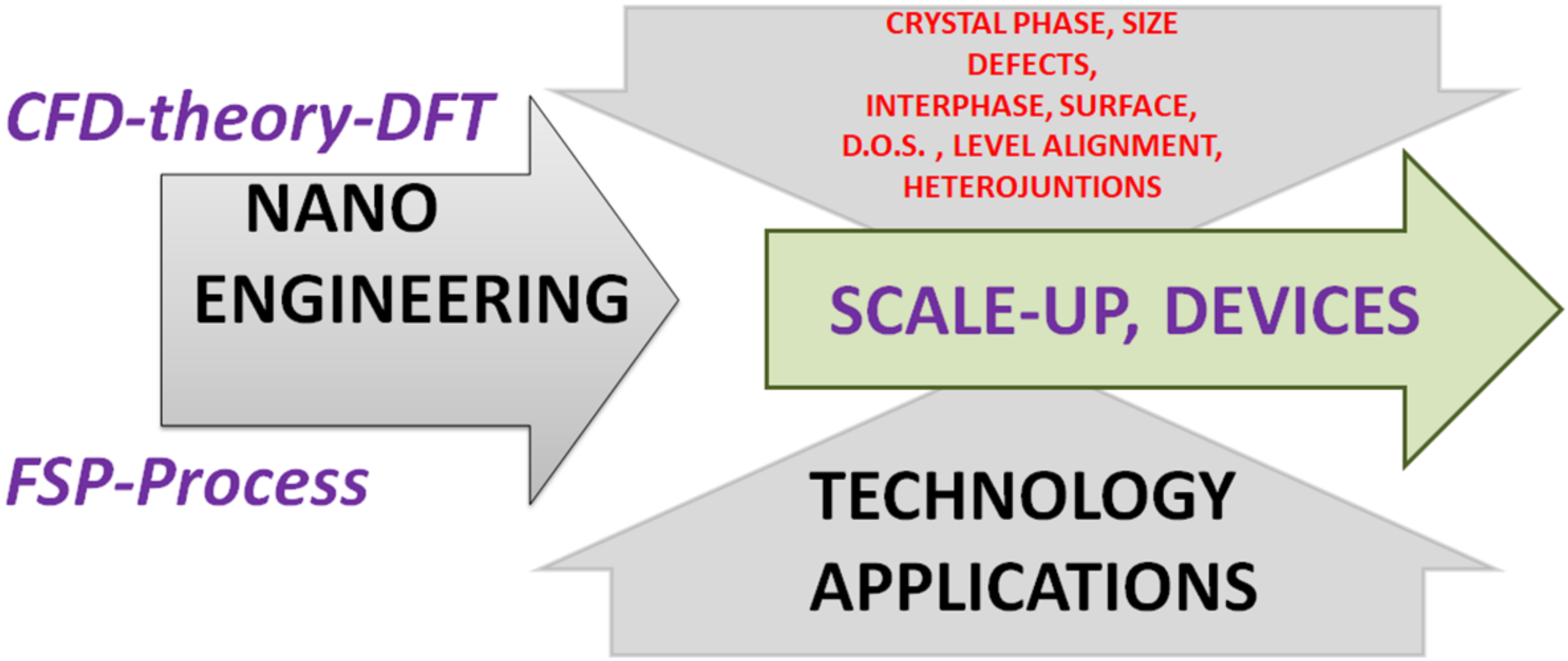
Welcome to the Nanomaterial's U.O.I Group

Recent Posts

- Nanoscale Journal front cover
- Scientific Reports- Publicatio...
- Publication- int.j.hydr.energy
- Instalation and Operation of S...
- Congratulations Dr Eleni Blets...

nanomaterials.physics.uoi.gr

Ι. Δεληγιαννάκης
Τμήμα Φυσικής



CFD-theory-DFT

NANO ENGINEERING

FSP-Process

CRYSTAL PHASE, SIZE
DEFECTS,
INTERPHASE, SURFACE,
D.O.S. , LEVEL ALIGNMENT,
HETEROJUNTIONS

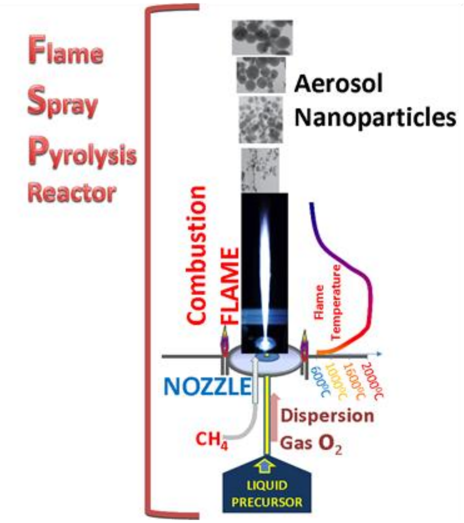
SCALE-UP, DEVICES

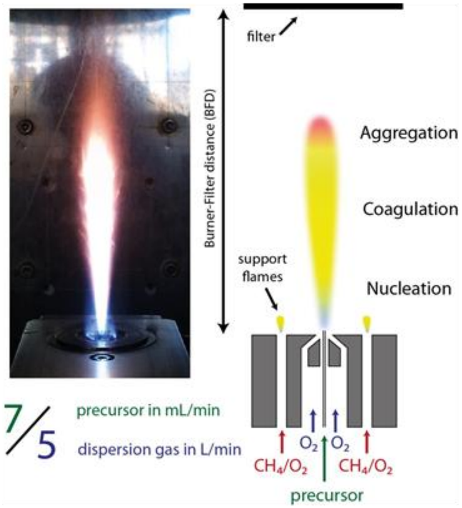
TECHNOLOGY APPLICATIONS

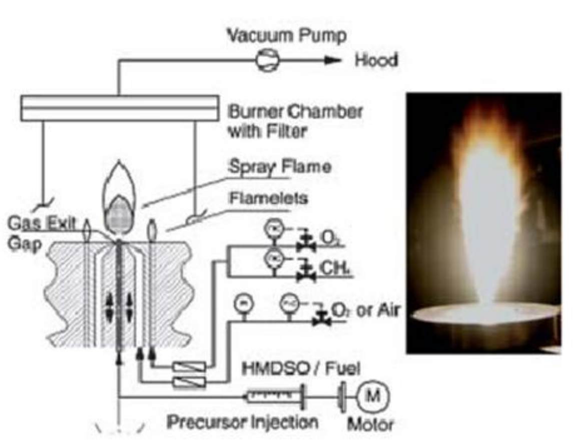
Flame Spray Pyrolysis*: A scalable technology for nanoparticle engineering

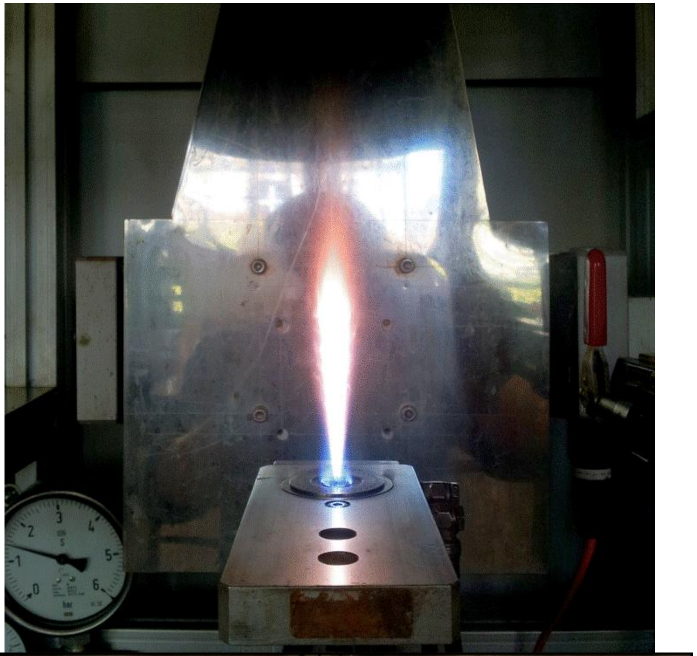
***Origianaly Developed at Particle Technology Laboratory ETH-Zurich**

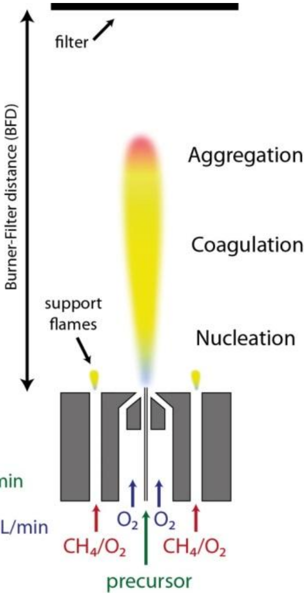
http//:www.ptl.ethz.ch





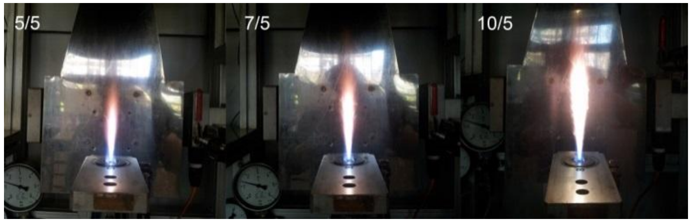


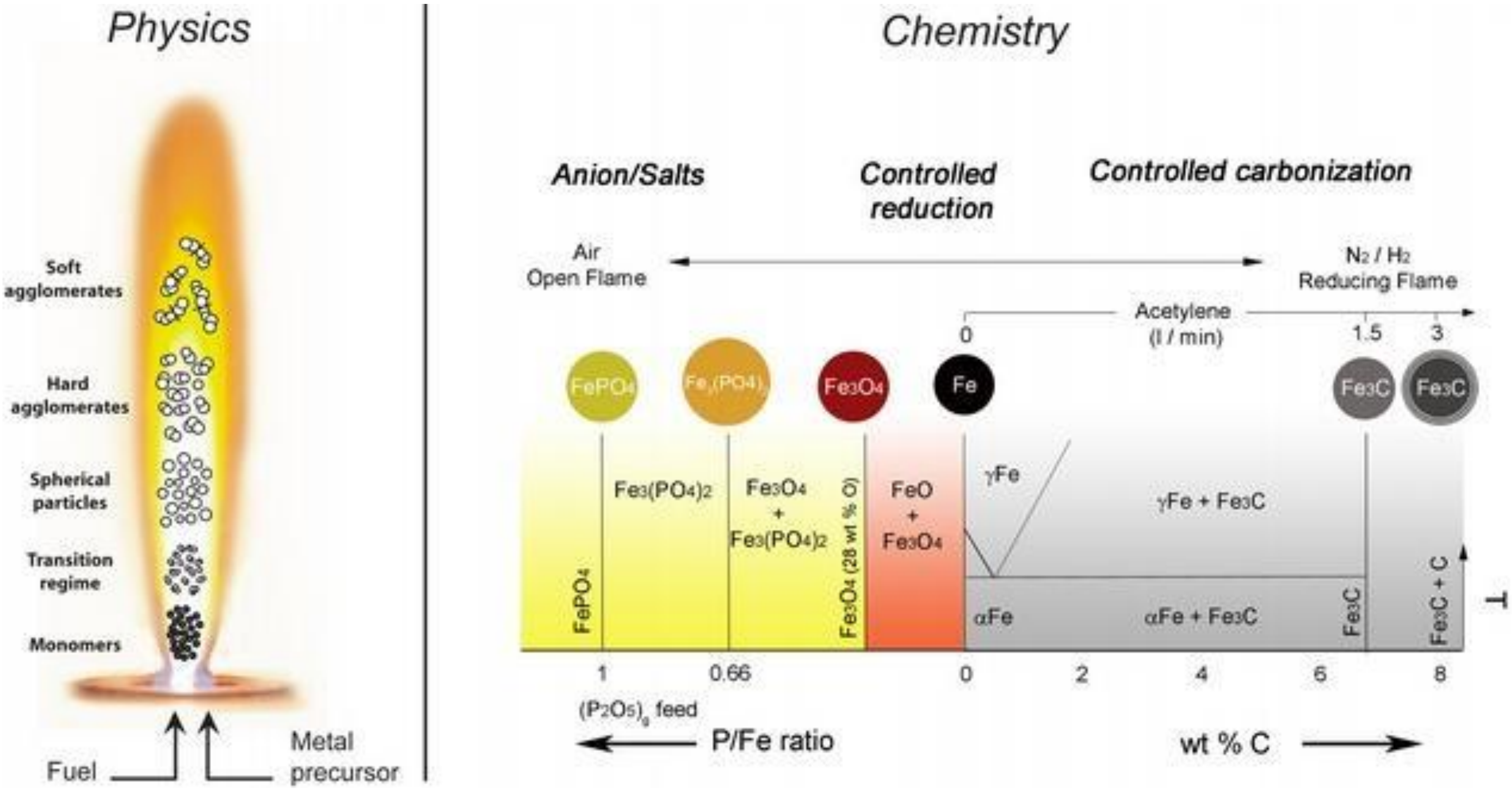


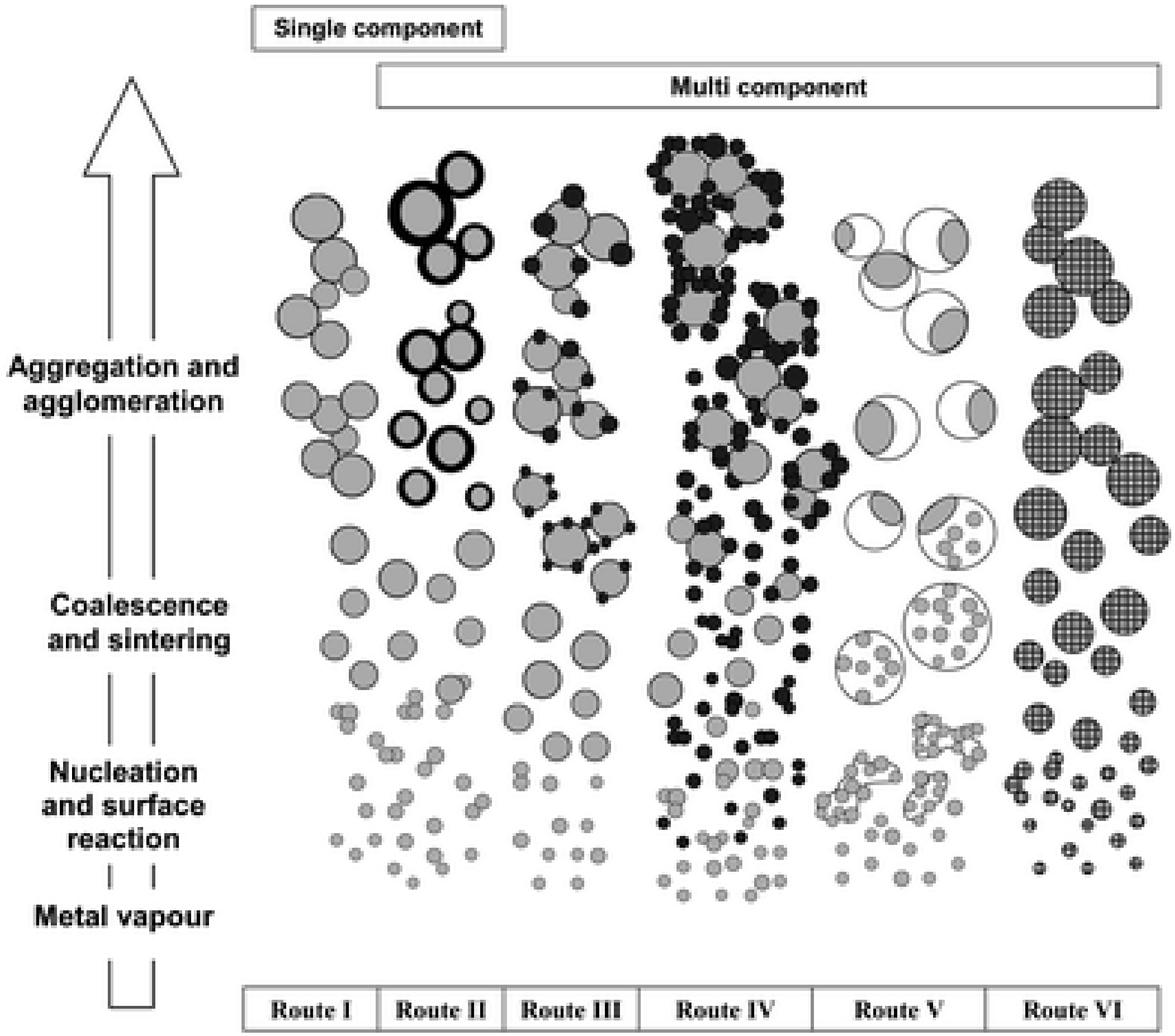


7/5 precursor in mL/min
dispersion gas in L/min

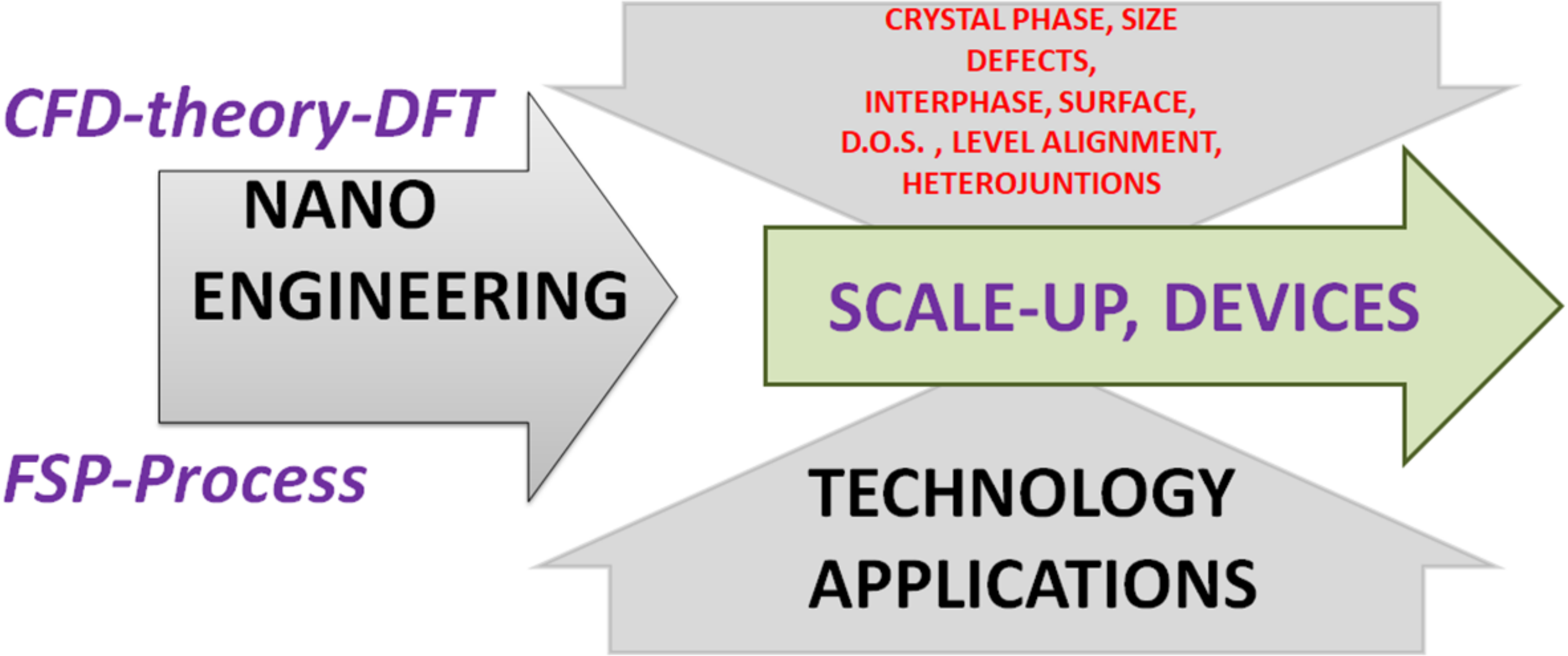

Double-Nozzle 7/5 - 7/5, 160°




Physics
Soft agglomerates
Hard agglomerates
Spherical particles
Transition regime
Monomers
Fuel
Metal precursor
Chemistry
Anion/Salts
Controlled reduction
Controlled carbonization
Air Open Flame
N2 / H2 Reducing Flame
Acetylene (l / min)
0
1.5
3
FePO4
Fe3(PO4)2
Fe3O4
Fe
Fe3C
Fe3C
Fe3(PO4)2
Fe3O4 + Fe3(PO4)2
Fe3O4 (28 wt % O)
FeO + Fe3O4
γFe
γFe + Fe3C
αFe
αFe + Fe3C
Fe3C
Fe3C + C
T
1
0.66
0
2
4
6
8
(P2O5)g feed
P/Fe ratio
wt % C


Single component
Multi component
Aggregation and agglomeration
Coalescence and sintering
Nucleation and surface reaction
Metal vapour
Route I
Route II
Route III
Route IV
Route V
Route VI

SCALE-UP PRODUCTION OF NANOMATERIALS Kilograms/hour



CFD-theory-DFT

NANO ENGINEERING

FSP-Process

CRYSTAL PHASE, SIZE
DEFECTS,
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D.O.S. , LEVEL ALIGNMENT,
HETEROJUNTIONS

SCALE-UP, DEVICES

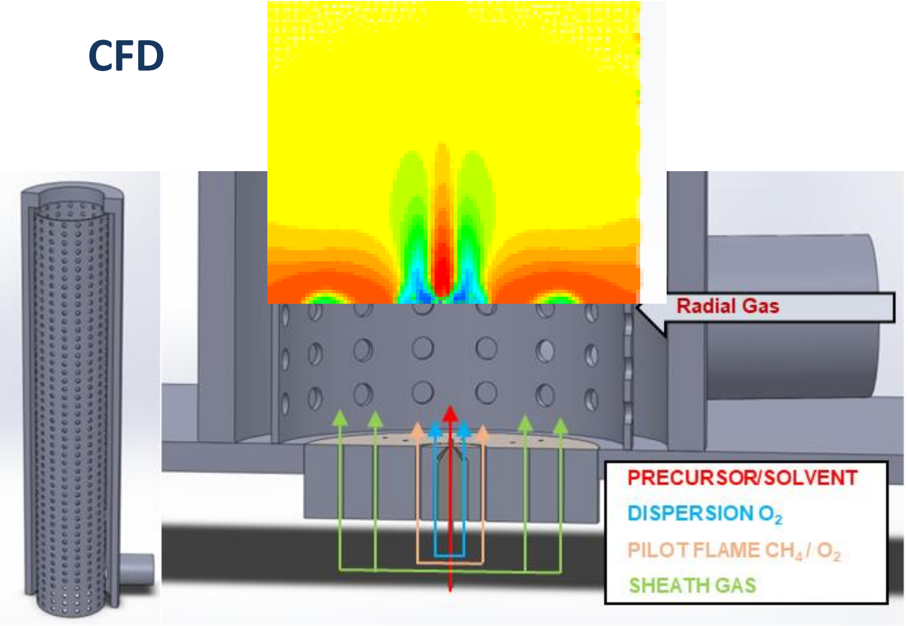
TECHNOLOGY APPLICATIONS

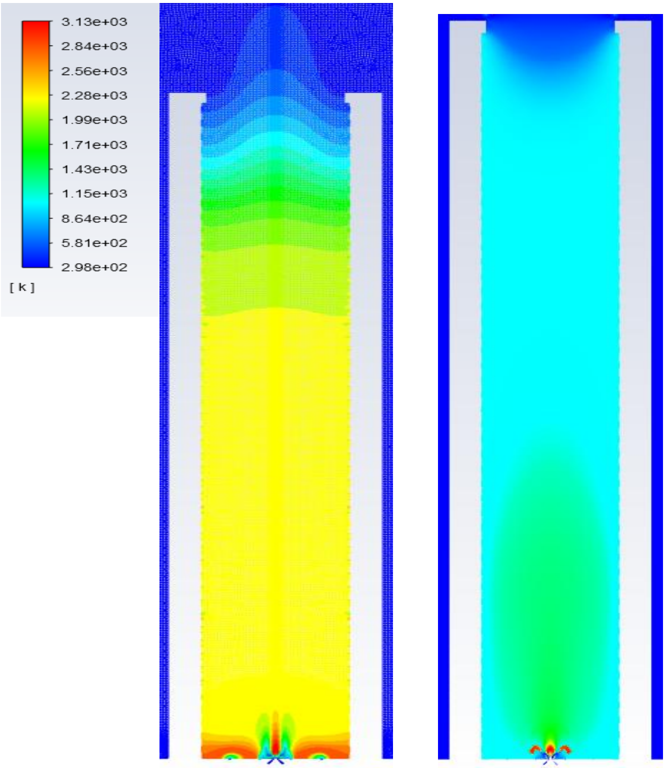
COMPUTATIONAL TOOLS

NANO-PARTICLE FORMATION PROCESS IN DROPLET-JET COMBUSTION (300-3000K)

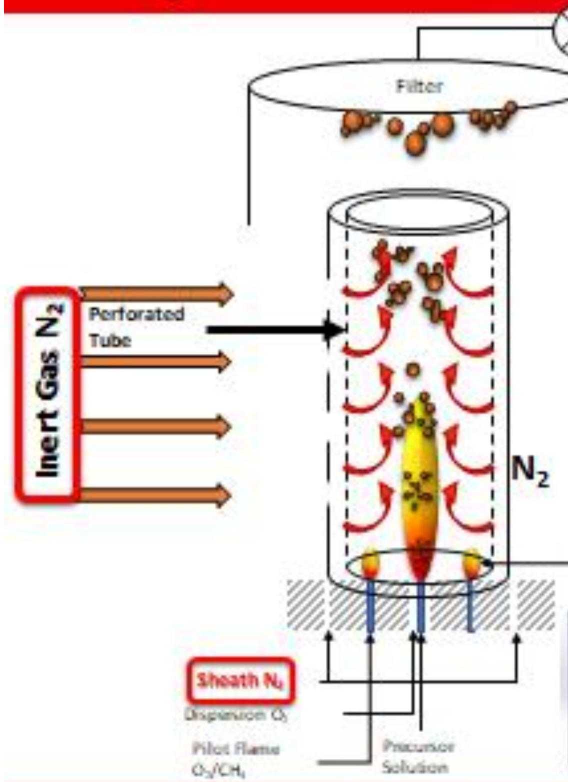
Computational Fluid Dynamics

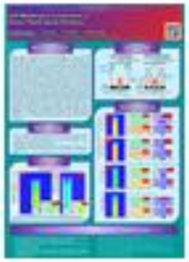
CFD

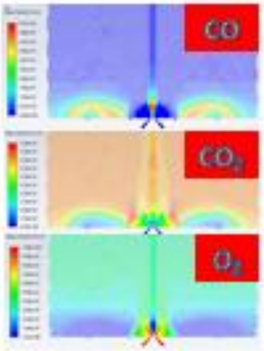


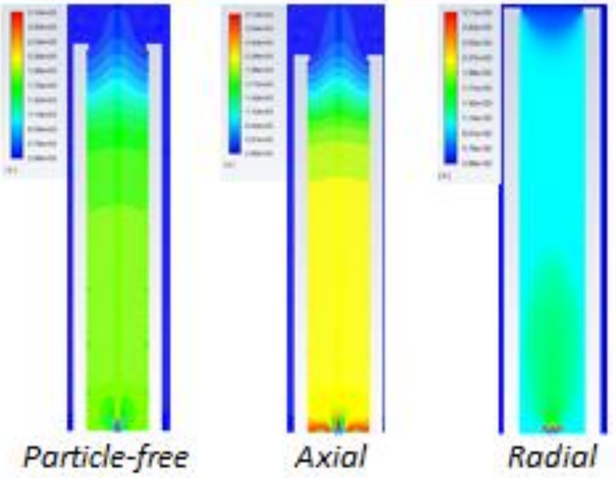


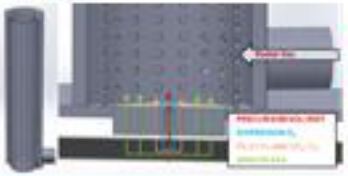
Computational Fluid Dynamics (ANSYS)





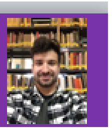


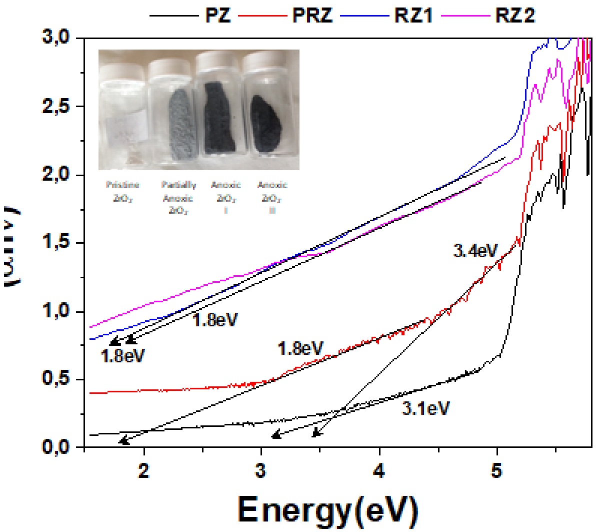

Particle-free *Axial* *Radial*

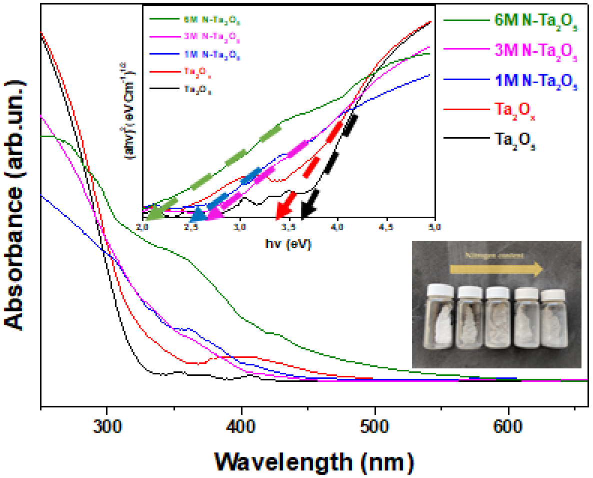


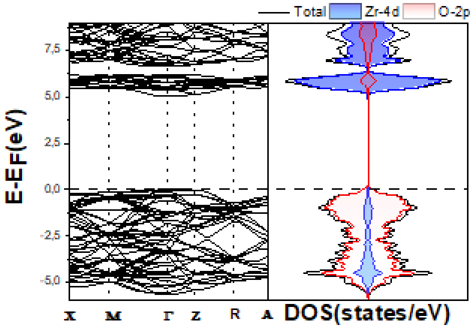
- **Axial CH4** injection promotes high combustion enthalpy and homogeneous temperature gradient
- **Radial CH4** injection oversaturates atmosphere and promotes flame cooling

BAND-GAP ENGINEERING by A-FSP

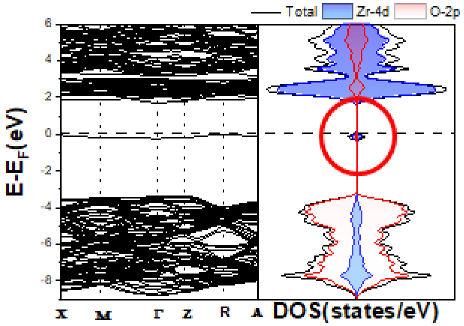






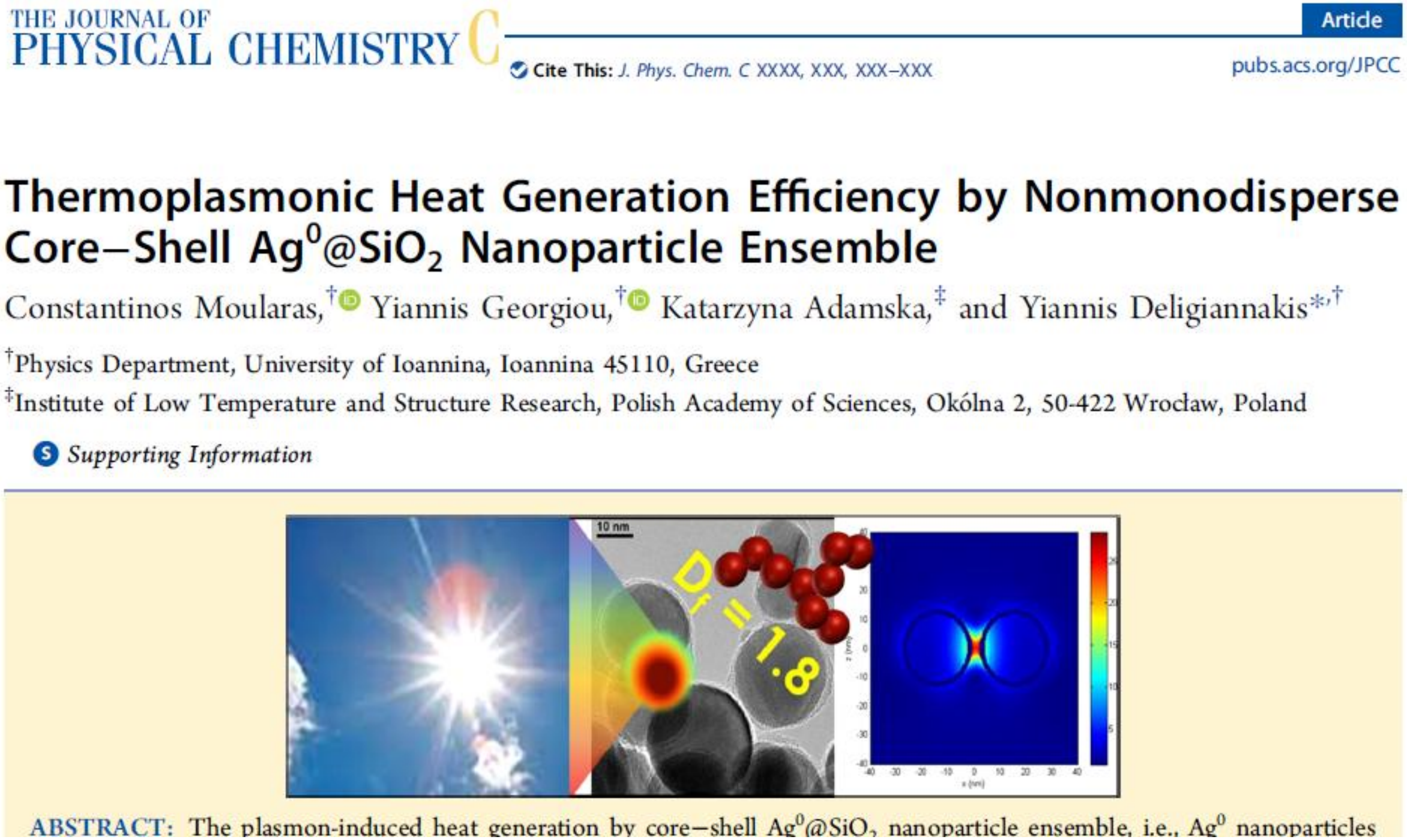


- Controlled band gap narrowing 5.6eV→1.8eV



Mantzanis, A; Deligiannakis, Y **Phys. Rev. B (2020)**

THEORETICAL-COMPUTATIONAL TOOLS **Mie Theory / ANSYS E/M**



THE JOURNAL OF PHYSICAL CHEMISTRY C

Article

Cite This: *J. Phys. Chem. C* XXXX, XXX, XXX−XXX

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Thermoplasmonic Heat Generation Efficiency by Nonmonodisperse Core−Shell $Ag^0@SiO_2$ Nanoparticle Ensemble

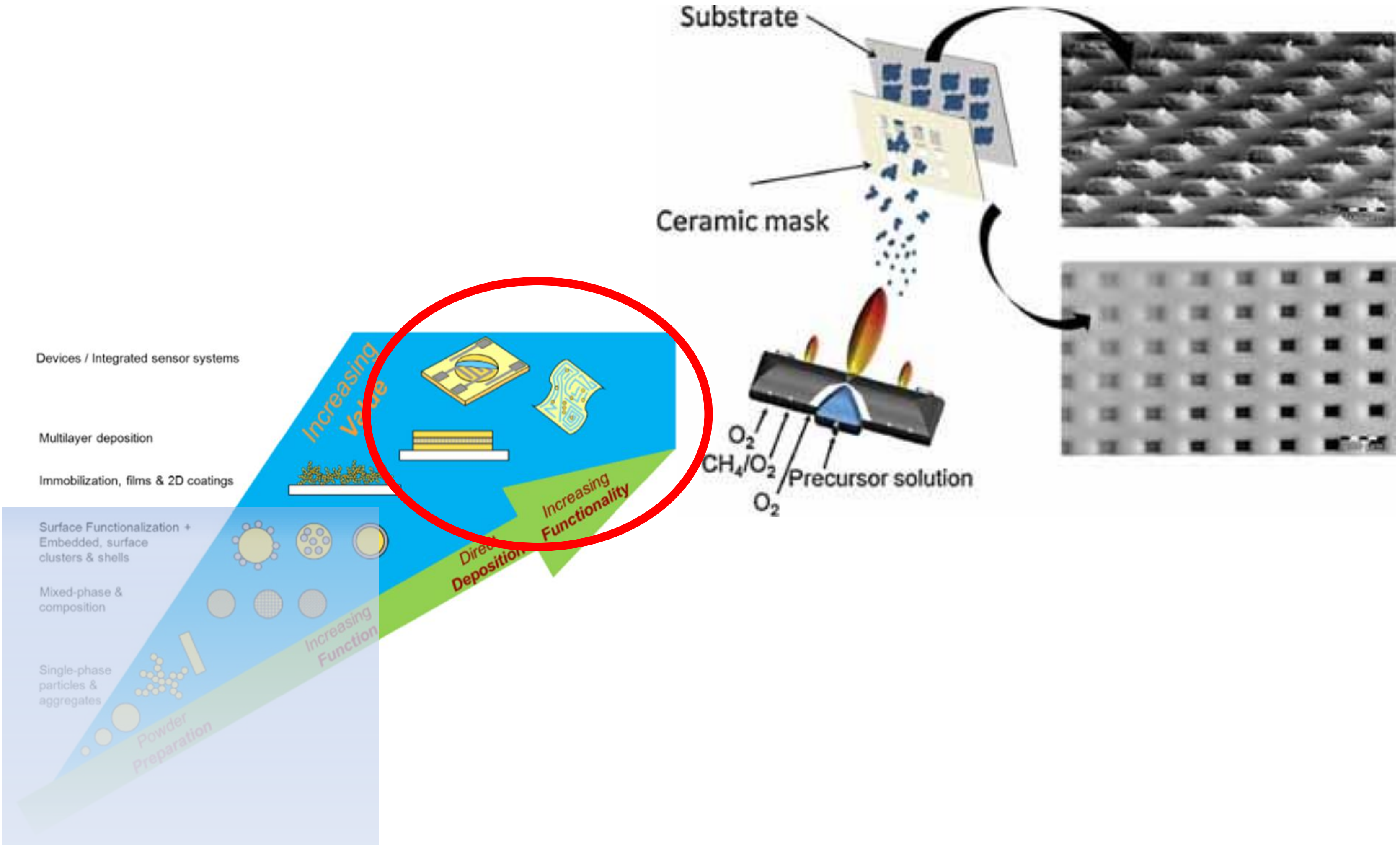
Constantinos Moularas,[†] Yiannis Georgiou,[†] Katarzyna Adamska,[‡] and Yiannis Deligiannakis*[,†]

[†]Physics Department, University of Ioannina, Ioannina 45110, Greece

[‡]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Okólna 2, 50-422 Wrocław, Poland

Supporting Information

ABSTRACT: The plasmon-induced heat generation by core−shell $Ag^0@SiO_2$ nanoparticle ensemble, i.e., Ag^0 nanoparticles


Devices / Integrated sensor systems
Multilayer deposition
Immobilization, films & 2D coatings
Surface Functionalization + Embedded, surface clusters & shells
Mixed-phase & composition
Single-phase particles & aggregates
Increasing Value
Increasing Functionality
Direct Deposition
Increasing Function
Powder Preparation
Substrate
Ceramic mask
O_2
CH_4/O_2
O_2
Precursor solution

GDCh
Forschungsartikel
Angewandte Chemie

Controlled Release *Hot Paper*

Deutsche Ausgabe: DOI: 10.1002/ange.201912312
Internationale Ausgabe: DOI: 10.1002/anie.201912312

Model-Based Nanoengineered Pharmacokinetics of Iron-Doped Copper Oxide for Nanomedical Applications

*Hendrik Naatz, Bella B. Manshian, Carla Rios Luci, Vasiliki Tsikourkitoudi, Yiannis Deligiannakis, Stefaan J. Soenen**

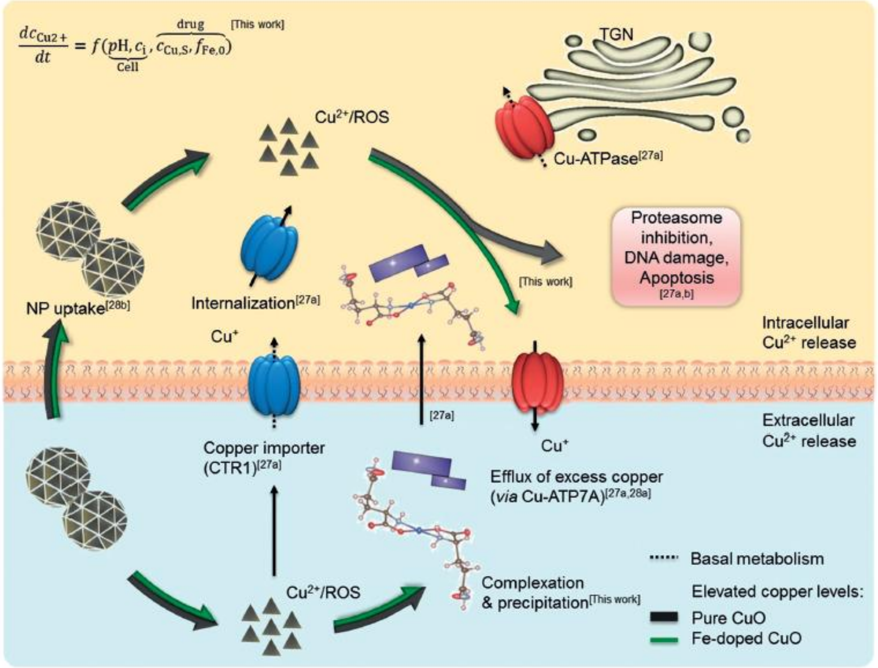
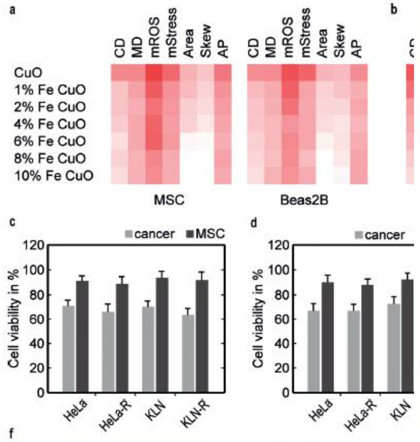


Figure 5. Copper homeostasis and regulatory mechanisms including extra- and intracellular dissolution of pure and Fe-doped CuO NPs. For the basal metabolism involving the secretory pathway, copper uptake is regulated by copper importing proteins, for example, CTR1. In case of



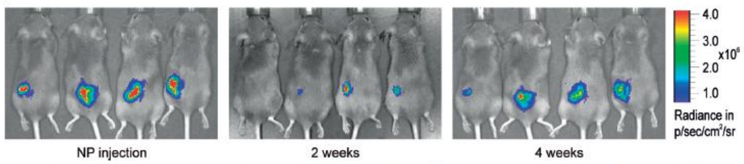


Figure 3. Therapeutic efficacy of Fe-doped CuO NPs against different cancer types. a,b) High content imaging data for the indicated cell types exposed to the different NPs at 12.5 $\mu g\,mL^{-1}$. The fold-difference compared to untreated control cells is indicated in color-code for CD = cell death, MD = membrane damage, mROS = mitochondrial ROS, mStress = mitochondrial stress, Area = cell size, Skew = cell skewness, and

www.nature.com/scientificreports

SCIENTIFIC REPORTS

OPEN

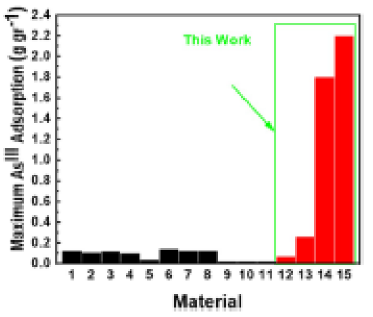
A Hybrid {Silk@Zirconium

Material as Highly Efficient

As^{III}-sponge

Yiannis Georgiou[1,2], Sofia Rapti[1], Alexandra Mavrogiorgou[1], Gerasimo
Manolis J. Manos[1,4], Maria Louloudi[1,4] & Yiannis Deligiannakis[2,4,5]

www.nature.com/scientificreports/



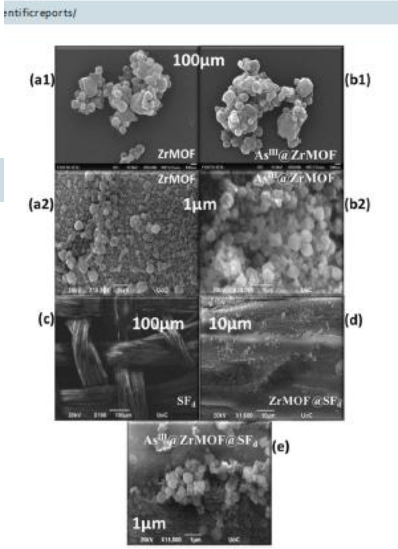


Figure 6. Maximum As^{III} adsorption capacity (g g^{-1}) at waters' near-neutral pH of some adsorbents reported in the literature compared with the present materials: 1) ZIF-8(cubic)[77], 2) ZIF-8(leaf)[77], 3) ZIF-8 (dodecahedral)[77], 4) Fe_3O_4@ZIF-8[78],5) HCl-UiO-66(SH)$_2$[79], 6) $CoFe_2O_4$@MIL-100(Fe)[48], 7) Fe_3O_4@MIL-101[80], 8) MIL-100(Fe)[16], 9) M600[16], 10) M800[16], 11) M900[16], 12) ZrMOF(this work), 13) cationic pZrMOF (this work), 14) SF$_4$ (this work), 15)neutral ZrMOF@SF$_4$ (this work).

Environmental
Science
Nano

ROYAL SOCIETY OF CHEMISTRY

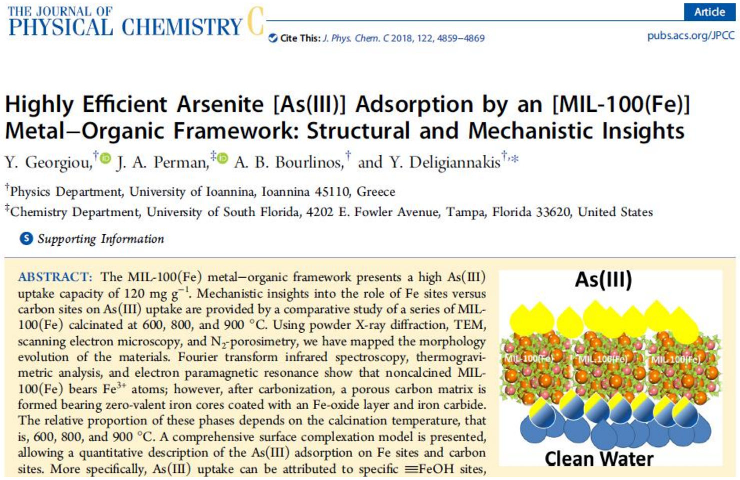
PAPER

Check for updates

Cite this: *Environ. Sci.: Nano*, 2019, 6, 1156

Mesoporous spinel $CoFe_2O_4$ as an efficient adsorbent for arsenite removal from water: high efficiency *via* control of the particle assemblage configuration†

Yiannis Georgiou,[a] Ioannis T. Papadas,[b] Eleftherios Mouzourakis,[a] Euaggelia Skliri,[b] Gerasimos S. Armatas*[b] and Yiannis Deligiannakis*[a]



THE JOURNAL OF
PHYSICAL CHEMISTRY C

Article

Cite This: *J. Phys. Chem. C* 2018, 122, 4859−4869

pubs.acs.org/JPCC

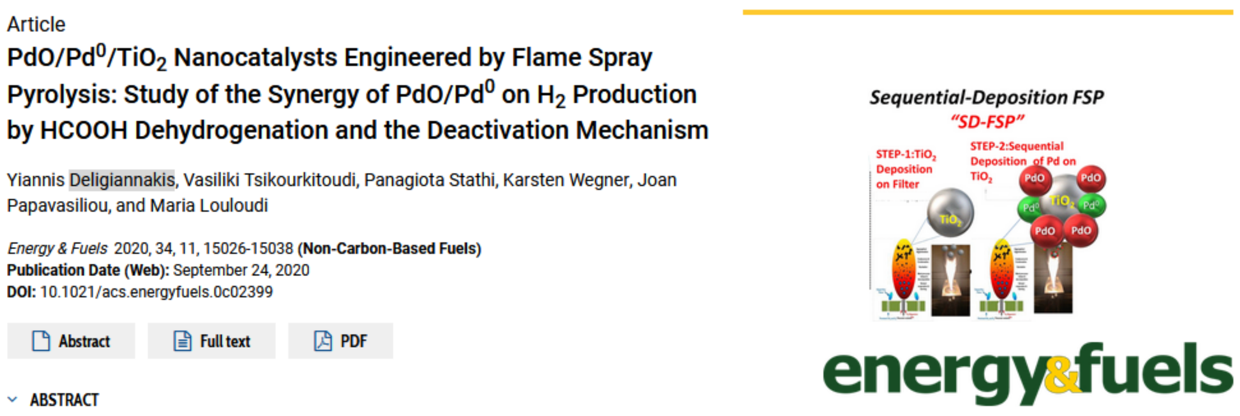
Highly Efficient Arsenite [As(III)] Adsorption by an [MIL-100(Fe)] Metal−Organic Framework: Structural and Mechanistic Insights

Y. Georgiou,[†] J. A. Perman,[‡] A. B. Bourlinos,[†] and Y. Deligiannakis[†,*]

[†]Physics Department, University of Ioannina, Ioannina 45110, Greece
[‡]Chemistry Department, University of South Florida, 4202 E. Fowler Avenue, Tampa, Florida 33620, United States

Supporting Information

ABSTRACT: The MIL-100(Fe) metal−organic framework presents a high As(III) uptake capacity of 120 mg g^{-1}. Mechanistic insights into the role of Fe sites versus carbon sites on As(III) uptake are provided by a comparative study of a series of MIL-100(Fe) calcinated at 600, 800, and 900 °C. Using powder X-ray diffraction, TEM, scanning electron microscopy, and N_2-porosimetry, we have mapped the morphology evolution of the materials. Fourier transform infrared spectroscopy, thermogravimetric analysis, and electron paramagnetic resonance show that noncalcined MIL-100(Fe) bears Fe^{3+} atoms; however, after carbonization, a porous carbon matrix is formed bearing zero-valent iron cores coated with an Fe-oxide layer and iron carbide. The relative proportion of these phases depends on the calcination temperature, that is, 600, 800, and 900 °C. A comprehensive surface complexation model is presented, allowing a quantitative description of the As(III) adsorption on Fe sites and carbon sites. More specifically, As(III) uptake can be attributed to specific ≡FeOH sites,



Article

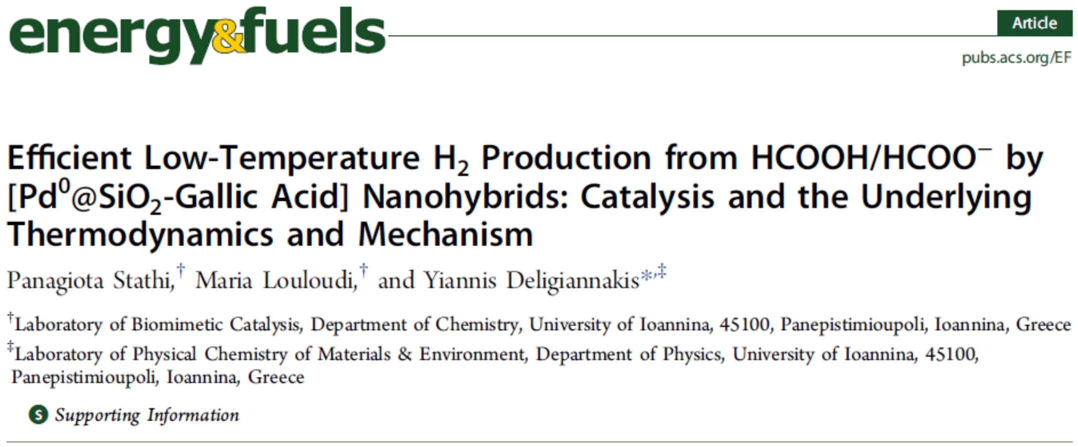
PdO/Pd^0/TiO$_2$ Nanocatalysts Engineered by Flame Spray Pyrolysis: Study of the Synergy of PdO/Pd^0 on H$_2$ Production by HCOOH Dehydrogenation and the Deactivation Mechanism

Yiannis Deligiannakis, Vasiliki Tsikourkitoudi, Panagiota Stathi, Karsten Wegner, Joan Papavasiliou, and Maria Louloudi

Energy & Fuels 2020, 34, 11, 15026-15038 **(Non-Carbon-Based Fuels)**
Publication Date (Web): September 24, 2020
DOI: 10.1021/acs.energyfuels.0c02399

Abstract Full text PDF

ABSTRACT



energy&fuels

Article

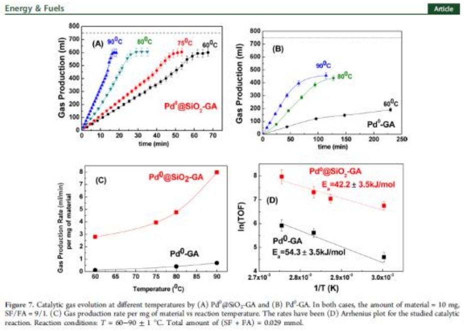
pubs.acs.org/EF

Efficient Low-Temperature H$_2$ Production from HCOOH/HCOO$^-$ by [Pd^0@SiO$_2$-Gallic Acid] Nanohybrids: Catalysis and the Underlying Thermodynamics and Mechanism

Panagiota Stathi,[†] Maria Louloudi,[†] and Yiannis Deligiannakis*,[‡]

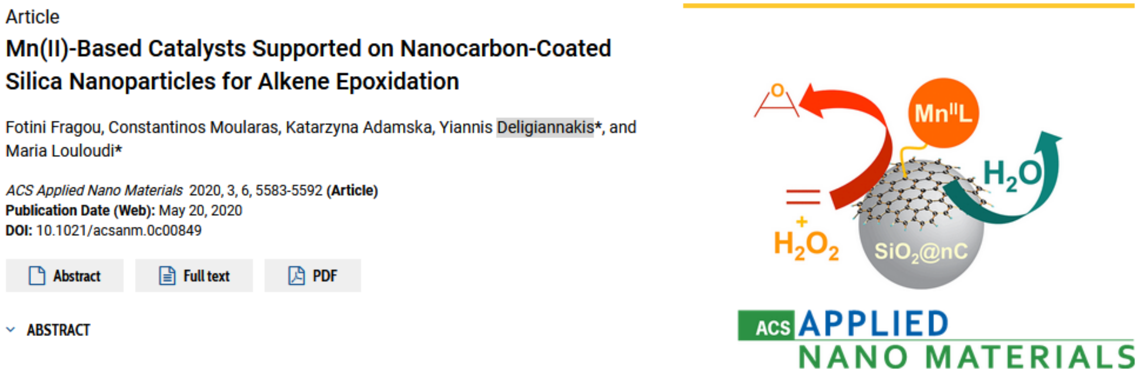
[†]Laboratory of Biomimetic Catalysis, Department of Chemistry, University of Ioannina, 45100, Panepistimioupoli, Ioannina, Greece
[‡]Laboratory of Physical Chemistry of Materials & Environment, Department of Physics, University of Ioannina, 45100, Panepistimioupoli, Ioannina, Greece

Supporting Information



Energy & Fuels Article

Figure 7. Catalytic gas evolution at different temperatures by (A) Pd^0@SiO$_2$-GA and (B) Pd^0-GA. In both cases, the amount of material = 10 mg, SF/FA = 9/1. (C) Gas production rate per mg of material vs reaction temperature. The rates have been (D) Arrhenius plot for the studied catalytic reaction. Reaction conditions: $T = 60-90 \pm 1$ °C. Total amount of (SF + FA) = 0.029 mmol.



Article

Mn(II)-Based Catalysts Supported on Nanocarbon-Coated Silica Nanoparticles for Alkene Epoxidation

Fotini Fragou, Constantinos Moularas, Katarzyna Adamska, Yiannis Deligiannakis*, and Maria Louloudi*

ACS Applied Nano Materials 2020, 3, 6, 5583-5592 **(Article)**
Publication Date (Web): May 20, 2020
DOI: 10.1021/acsanm.0c00849

Abstract Full text PDF

ABSTRACT

ARTIFICIAL PHOTOSYNTHESIS

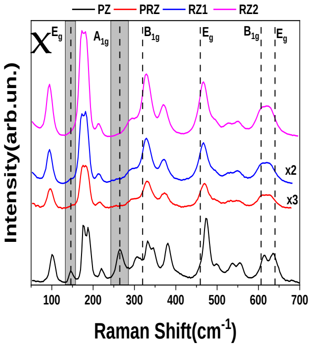
ΕΛΙΔΕΚ

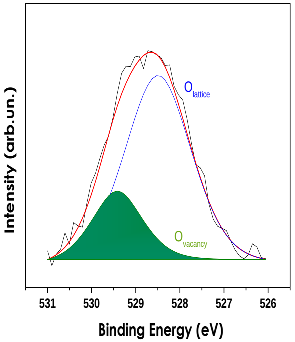
WWW.nARTPHOTO.PHYSICS.UOI.GR

Lattice Distortion (XPS-Raman)

Oxygen Defects

ZrO_{2-}

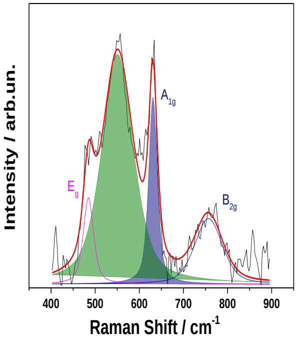


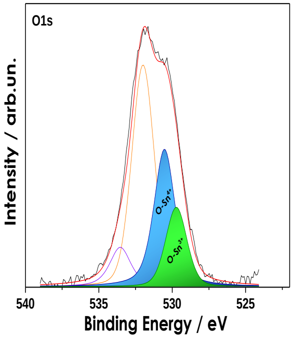


SnO_{2-}

Eg, A1g, B2g – Active modes

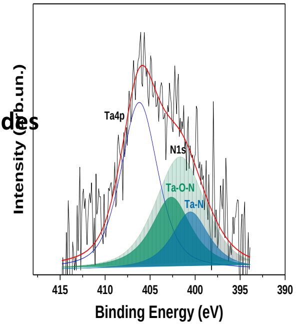
— Defect X mode (surface)

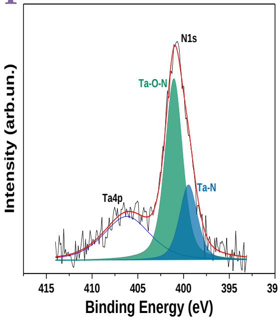


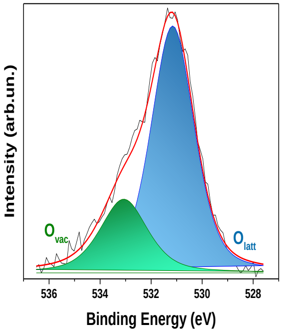


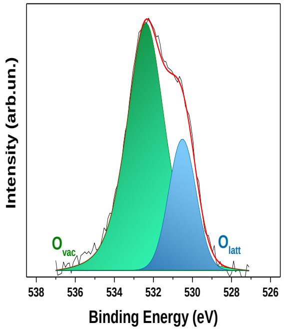
N-doping

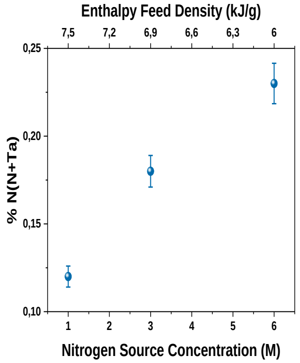
(A-FSP assisted N-rich atmosphere)





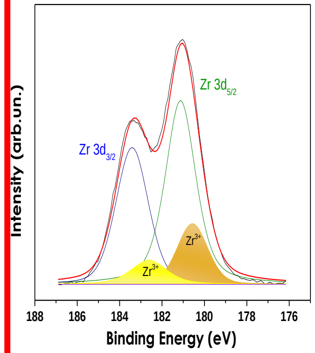


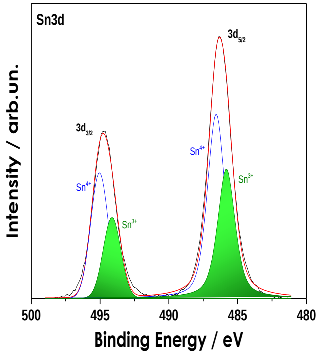


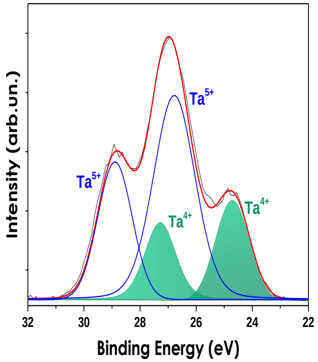


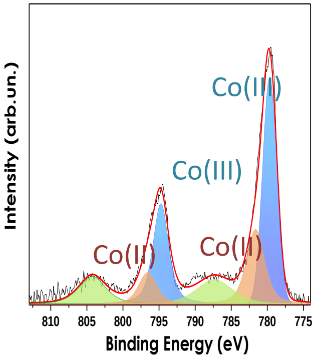
One-electron Reduction

$M^{n+} \rightarrow M^{(n-1)+}$ species







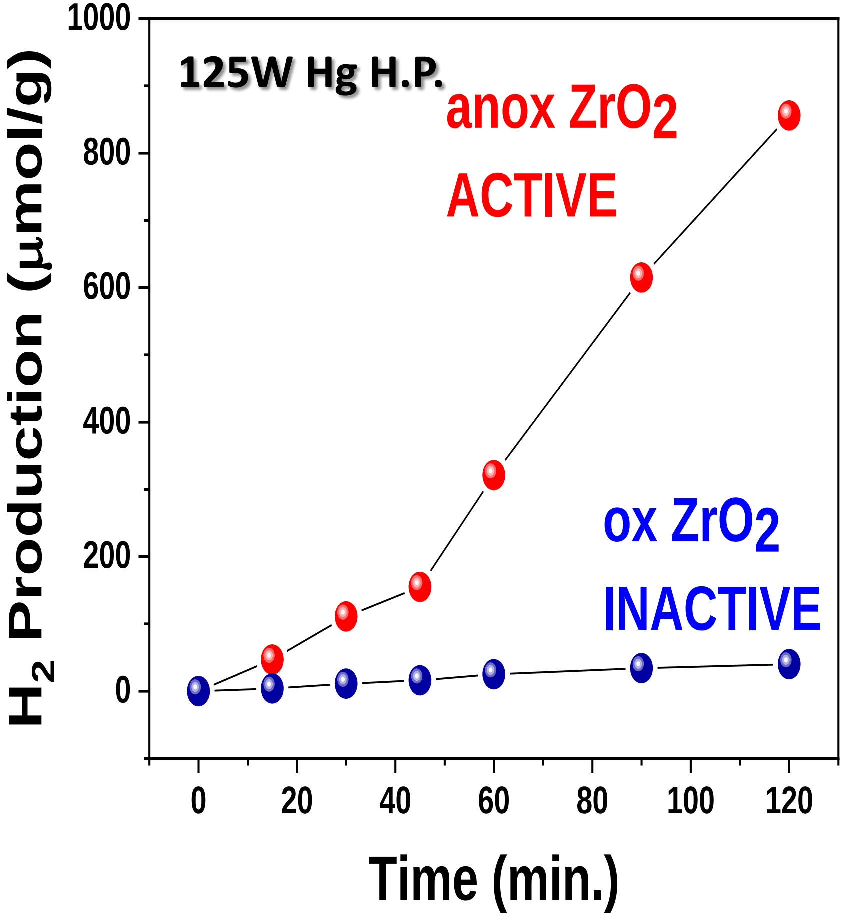


4th Gas Phase Symposium Duisbourg 6-9Okt 2020

Dept Physics, Univ. of Ioannina, Greece

UNIVERSITY OF IOANNINA

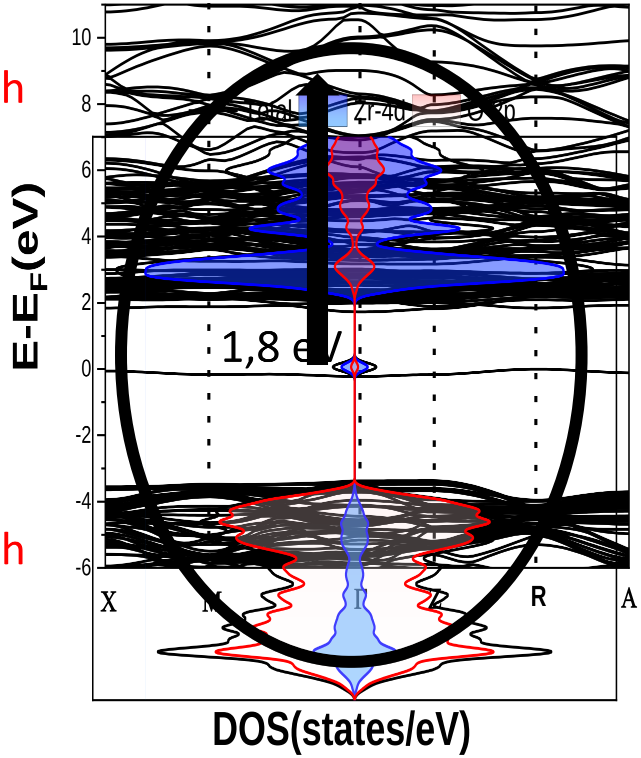
Catalytic Performance-
H_2O photocatalysis/production of H_2



589 μmol/gh

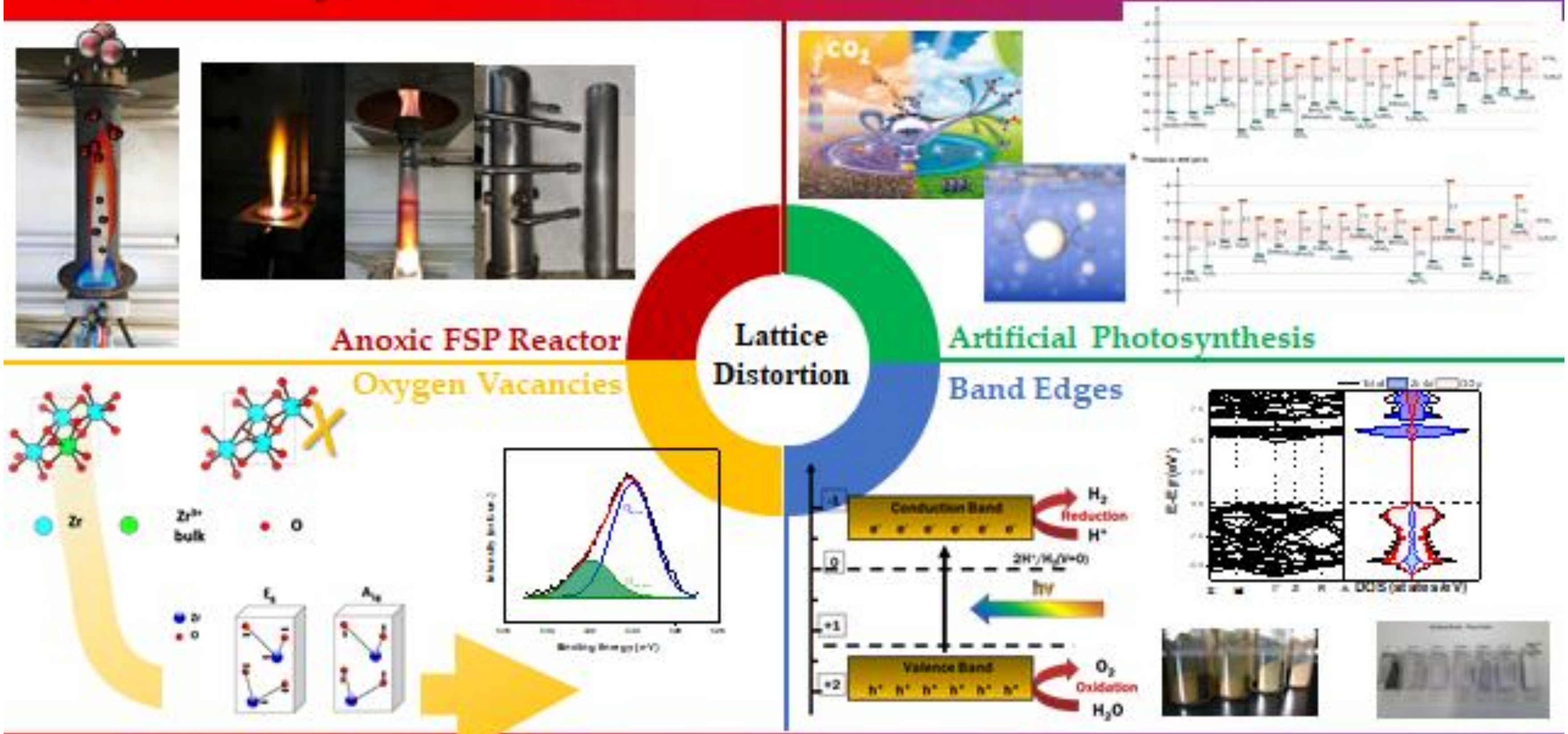
25 μmol/gh

Defect introduction → new stat
→ enhancement of catalytic ac



Mantzanis, A; Deligiannakis, Y **Phys. Rev. B (2020)**

Nano Catalysts for ARTIFICIAL PHOTOSYNTHESIS



Anoxic FSP Reactor

Lattice Distortion

Artificial Photosynthesis

Oxygen Vacancies

Band Edges

H.F.R.I.
Hellenic Foundation for Research & Innovation

The research work was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I) under the “First Call for H.F.R.I Research Projects to support Faculty members and Researchers and the procurement of high-cost research equipment grant” (Project Number: HFRI-FM17-1888)

European Union
European Social Fund

Operational Programme
Human Resources Development, Education and Lifelong Learning
Co-financed by Greece and the European Union

ΕΣΠΑ
2014-2020

Programme «Human of the project “Development of Reducing Suboxic Nanophotocatalysts by Flame Spray Pyrolysis” (5047631).” Resources Development, Education and Lifelong Learning 2014- 2020» in the context

EU GREEN-DEAL *MePhoto*
EU-ITN *FlameU*

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PARIS

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Particle Technology Laboratory

ETH
Eidgenössische Technische Hochschule Zürich

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MAX-PLANCK-INSTITUT
FÜR EISENFORSCHUNG GMBH

IWT
Leibniz-Institut für

Leibniz

TITAN
GREECE

Lab Members

Post Docs

Dr. Panagiota Stathi – FSP-made Catalysts, CO_2 reduction reactions
Maria Solakidou - H_2 evolution reactions, H_2O Splitting

PhD Candidates

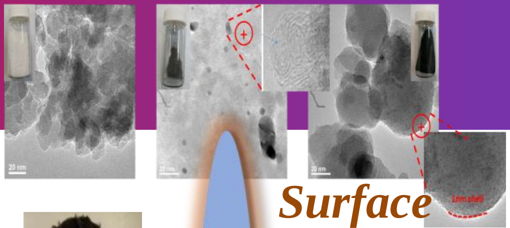
Constantinos Moularas - Plasmonics, Atmosphere in gas-phase processes
Pavlos Psathas - FSP perovskites & doping engineering
Areti Zindrou - FSP tailoring of Cu subox-phase composition
Asterios Mantzanis - Flame-induced defects in ZrO_2 particles
Christos Dimitriou - Gas-phase engineering of quantum dots

MSc Students

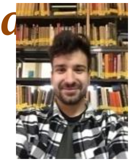
Orestis Nikas
Loukes Belles

http://nanomaterials.physics.uoi.gr/

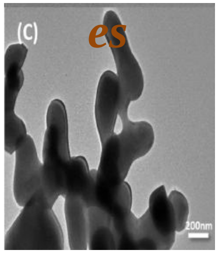
Fragou et al. *ACS Appl. Nano Mater.* (2020)



Surface Modification



Perovskites



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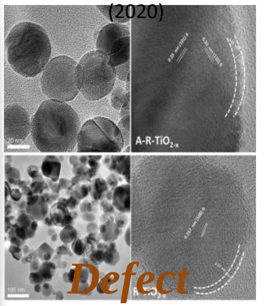

Defect Engineering

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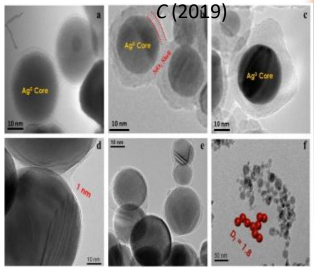
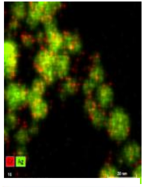
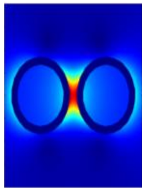


PHOTOCATALYSTS

Plasmonic Enhancers





Particle Protection