

The logo for TECNAN, featuring the word "TECNAN" in a blue, sans-serif font. The letter "C" is stylized with an orange circle inside it. The logo is set against a white rectangular background.

TECNAN

TECNOLOGÍA NAVARRA DE NANOPRODUCTOS, S.L.

Madrid, 11 de Septiembre 2012

TECNOLOGÍA NAVARRA DE
NANOPRODUCTOS S.L. (TECNAN)

THINK BIG, ACT NANO!

TECNAN IN BRIEF



- **Foundation:** December, 2007 – CENTRO TECNOLÓGICO LUREDERRA
- **Activity:** Industrial scale production and commercialisation of advanced nanoparticles for multisectoral applications as well as other nanoproducts based on them.



SPECIAL CHARACTERISTICS

- © Unique technology for large-scale production and supply guarantee
- © Outstandingly versatile offer of customised products
- © Availability of top-quality complex oxides for specific applications
- © Highly active in RTD with continuous product evolution and participation in long-range projects
- © Relevant presence in events related to nanotechnology: NANOTECH Japan/Berlin, Imagenenano, Euro Nano Forum Budapest...
- © Global product distribution with partners in Japan, United States, Germany & Rusia among others

PRODUCTS LINES



1. POWDER NANOPARTICLES:

- SIMPLE NANOPARTICLES
- COMPLEX NANOPARTICLES



2. DISPERSIONS:

Nanoparticles in liquid format, dispersed in different medias and concentrations according to the clients demands, in order to facilitate the implementation of our nanomaterials by end-users.,



3. TECNADIS – READY TO USE NANOPRODUCTS:

Nanoparticle-based compositions ready to be directly applied on different substrates.



**TECNADIS PRS
EFFECT**



TECNADIS GWR



**TECNADIS PRS
SHINE**



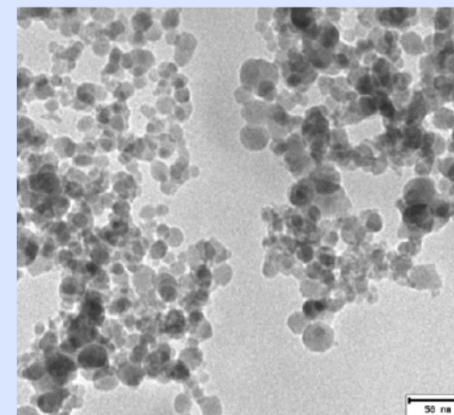
**TECNADIS PRS
PERFORMANCE**



**TECNADIS PRS
FLOOR**

NANOPRODUCTS' CHARACTERISTICS

- Low sizes (7-25 nm) → high SSA → high efficiency
- High purity
- Narrow size distribution
- High chemical & thermal stability
- High dispersion capacity
- Low Agglomeration
- Wide variety → Different sectors



H																	He	
Li	Be											B	C	N	O	F	Ne	
Na	Mg											Al	Si	P	S	Cl	Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	Ac	Rf	Ha	Unh	Uno	Une											
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		

■ Pyrolytic process

■ Traditional technology



NANOPARTICLES - Examples

SIMPLE OXIDES

- Aluminum Oxide (*nano-Al₂O₃*)
- Cerium Oxide (*nano-CeO₂*)
- Iron Oxide (*nano-Fe₂O₃*)
- Titanium Oxide (*nano-TiO₂*)
- Zinc Oxide (*nano-ZnO*)
- Zirconium Oxide (*nano-ZrO₂*)
- Silicon Oxide (*nano-SiO₂*)
- Yttrium Oxide (*nano-Y₂O₃*)
- Hafnium Oxide (*nano-HfO₂*)

COMPLEX OXIDES

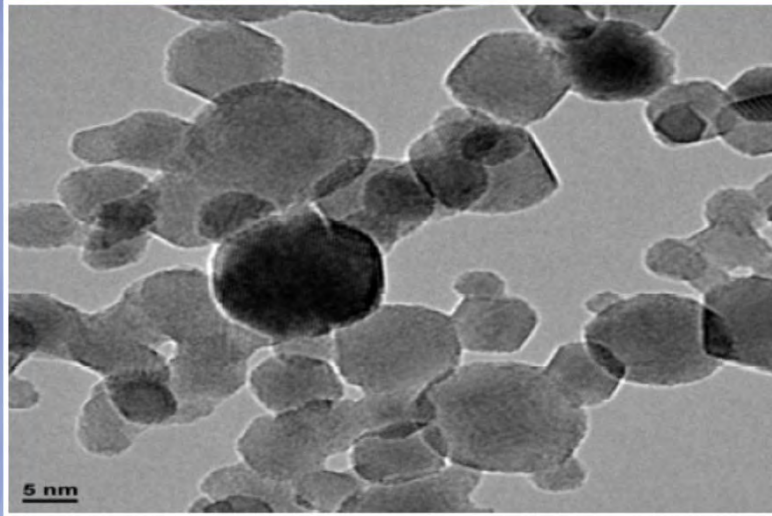
- *nano- ZnO / TiO₂*
- *nano-TiO₂ / V₂O₅*
- *nano-CeO₂ / ZrO₂*
- *nano-ZrO₂ dopped Yttria (YSZ)*.
- *nano- Fe₂O₃/CoO*
- *nano-mixed oxides with complex structures.*



TECNAN is the only company in the world that has the capacity of producing mixed nano-oxides of various elements in large-scale for multisectoral applications. These new complex nano-oxides are becoming most demanded by multinational companies as more efficient nanoparticles than simple nano-oxides for specific industrial applications: cosmetic, electronic, energy, catalyst, paint, construction, etc.

NANOPARTICLES - Examples

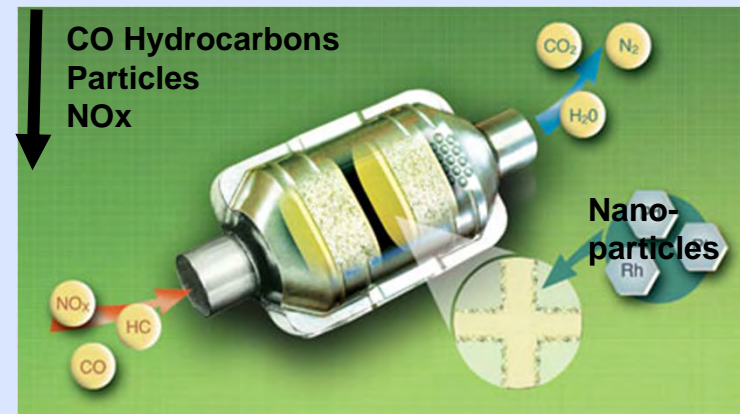
Mixed oxide of Cerium & Zirconium (6%wt in CeO₂)



TEM pictures: NPs of around **10nm**.
Mostly spherical (ZrO₂) but slight cubic crystallinity can be appreciated (CeO₂). **Low agglomeration**.

Application in Catalysis

According to essays CZ mixture shows great homogeneity resulting in the enhance of Pt catalytic activity



NANOPARTICLES - Examples

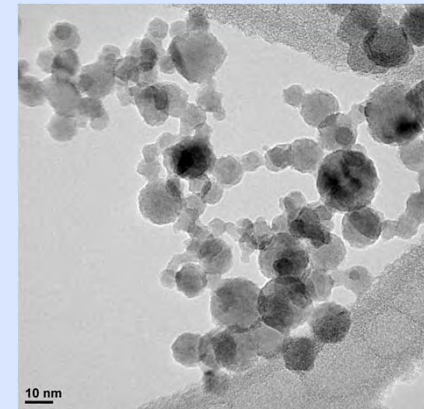
ADVANCED SPECIAL OXIDES:

New Nanoparticles – New/Better applications

From Kilograms to Tonnes

- ***TiO₂ with tailored reactivity with radiation:***
 - *Reduction of free radical release*
 - *Maintaining photocatalytic effect*

- ***Mixed and doped TiO₂ with advanced photocatalytic effect: wide spectrum range also for indoor applications (active with visible light).***

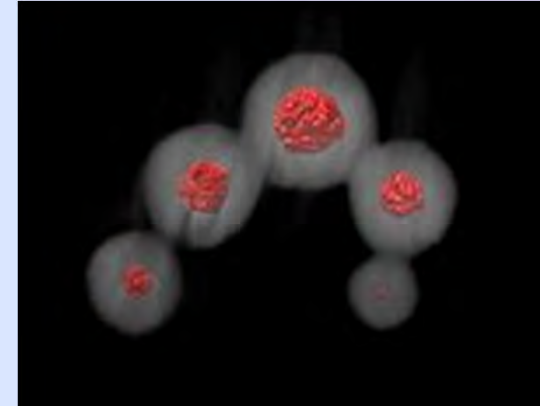


NANOPARTICLES - Examples

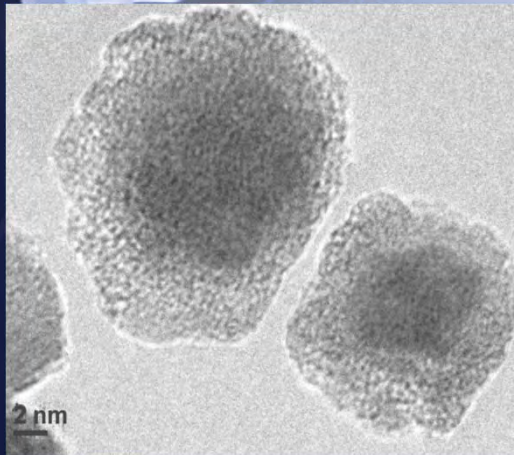
ADVANCED SPECIAL OXIDES:

Layered Nanoparticles

From Kilograms to Tonnes



Different functionalities in one nanoparticle!!!



EXAMPLE OF LAYERED NANOPARTICLES WITH COMBINED EFFECTS BASED ON *Nano-ZnO*:

- **FIRST LAYER:** Strong photocatalytic effect (ZnO)
- **SECOND LAYER:** Transparent to radiation and able to diminish free radical generation acting like a “barrier” (other nano-oxide)

ADVANTAGES: Avoiding degradation of host matrix as well as negative effects of free-radicals in living organisms, cells,...

APPLICATIONS: Awnings, sunscreen lotions, etc.

DISPERSIONS - Examples

NANOPOWDERS DISPERSIONS IN WATER:

- Dispersions at a concentration of 5%
- Dispersions at a concentration of 10%
- Dispersions at a concentration of 15%
- Dispersions at a concentration of 20%



NANOPOWDERS DISPERSIONS IN ISOPROPANOL:

- Dispersions at a concentration of 5%
- Dispersions at a concentration of 10%
- Dispersions at a concentration of 15%
- Dispersions at a concentration of 20%

Available other solvents such as ethanol, THF, cyclopentanone and MEK among others

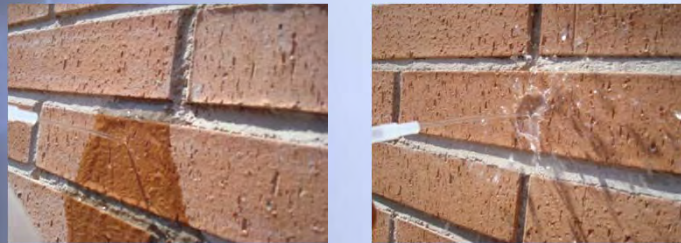


THE HIGH QUALITY AND STABILITY OF TECNAN DISPERSIONS IS SUPPORTED BY THE INTERNAL CHARACTERIZATIONS AND BY THE EXTERNAL LABORATORIES AND END USERS.

READY TO USE NANOPRODUCTS - Examples

TECNADIS PRS EFFECT

- A solution to ensure material long term protection against water preventing or slowing down its harmful effects on mineral substrates (porous substrates).



Excellent hydrophobic, transparent and totally breathable.

TECNADIS PRS PERFORMANCE

- Water and oil repellent nanoparticle-based composition that protects porous surfaces and facilitates removal greasy and oily stains and common water-based dirt



TECNADIS GWR

- Hydrophobizing vitreous surfaces to help water removal and protecting the material against excessive dampness accumulation.



TECNAN'S UNIQUE TECHNOLOGY



TECNAN production line

**Multi-Kg / h
nanoparticle
production rate**



Nanoparticle production

High Purity

**Flexible process
enabling specific
solutions:**

**Mixed, doped, binary,
ternary species, etc.**

**Oxides, Phosphates &
Carbonates**

**Versatile
technology:
products with nearly
every element from
the periodic system**

Tecnan's Unique Technology

- Excellent for UPSCALING: Current equipment
1Kg/h

Extrapolable by the construction of parallel machines

-FP7 EU project in progress, for the construction of
an upscaled device of 5Kg/h (envisaged in 18
months)

Extrapolable by the construction of parallel
machines

Eco-friendly

**No waste
products are
generated**

Small size

**One-step
process**

**Competitive
prices**

Products & Applications

TECNAN'S INDUSTRIAL APPROACH

Industrial capacity along the whole process :

Large-scale production equipments based on Advanced technologies

Possibility of multiplied production with various equal machines in parallel



Nanopowder production
2 Tn/year

Pilot-scale NP production
equipment 100 g/h



Equipment with production rate of 10 Tn/year **UNDER CONSTRUCTION**

TECNAN'S INDUSTRIAL APPROACH

Industrial capacity along the whole process :

Large-scale equipment for:

- ① Customised nanodispersions to facilitate direct NP incorporation in market products
- ① Ready-to use nanotechnology-based products



Possibility of multiplied production with various equal machines in parallel

Industrial Line for nanodispersions and ready to use nanoproducts



APPLICATIONS OF TECNAN PRODUCTS IN SECURITY & DEFENSE

TRANSPARENCY

- **TCOs** (Transparent Conductive Oxides): For pieces and coatings mainly in electronic devices
i.e: ITO, AZO
- **Transparent Ceramics:**
 - To substitute glass elements in Night Vision devices or electromagnetic windows - Improvement of abrasion resistance, strength and thermal stability.
 - As optical materials for specific lasers.
i.e: YAG, $MgAl_2O_4$ and doped CuO, MnO, SiO among others
- **New shields:** To obtain transparency and provide maximum resistance without high weights.
i.e: mixed nanoparticle of Al_2O_3/SiO_2

MAGNETISM

- **Improved magnets:** They make possible the miniaturisation and weight reduction of devices such as engines as well as the use of new weapons like the railgun.
i.e: : $Nd_{0.047}Fe_{0.33}B_{0.024}O_{0.6}$ ($Nd_2Fe_{14}B$) or $Sm_{0.04}Co_{0.36}O_{0.6}$ ($SmCo_5$)
- **Magnetorheological fluids:**
 - For fast reinforcement of military cloth pieces or sudden transformation of temporary rigid structures like an emergency communication post, a stretcher or a splint.
 - To improve the response in dampers which are subjected to extreme battle conditions.
i.e: multilayered nanoparticle of $SiO_2@Fe_3CoO_4$

APPLICATIONS OF TECNAN PRODUCTS IN SECURITY & DEFENSE

MERGING INTO LANDSCAPE (Energy demand) / INVISIBILITY

Current developments for camouflage are related to the use of electronic panels covering usually tanks, vehicles, planes, etc. able to project images of the surrounding appearance as well as to change thermal patterns to avoid infrared detectors.

➤ **New energy storage devices** like flux batteries by the use of new nanomaterials for highly active electrodes.

i.e: highly conductive multilayered nanoparticle of $\text{SiO}_2@Ag$

➤ **Li-ion batteries** could be also improved with highly active nanomaterials

i.e: : LTO and LiCoO_2 (cathode)

➤ **New complex nanomaterials** are being developed to be deposited over solar panels so as to increase the quantity of visible light available for its transformation into electricity, taking advantage of additional radiations like IR and UV.

i.e: mixed/doped species like $\text{Y}_2\text{O}_3/\text{Eu}$, $\text{Y}_2\text{O}_3/\text{Yb}^{3+}$, $\text{ZrO}_2/\text{Er}^{3+}$

Those and other complex nanomaterials can be also used for distraction or camouflage since depending on the wavelength of the light projected a coating of those materials would show another different color.

APPLICATIONS OF TECNAN PRODUCTS IN SECURITY & DEFENSE

VISIBILITY DISTORSION

➤ **Coatings of nanocrystals:** To distort normal light behavior over objects providing new possibilities of refraction and reflection, both mirror and diffuse, as well as anti-reflective to avoid revealing the position of moving units with glass components.

i.e: Antireflection – TiO_2 , multilayered nanoparticle of $\text{SiO}_2@Au$, $\text{Al}_2\text{O}_3@Ag$, SiO_2 (also functionalized) and hollow NPs of SiO_2 with silica shell thickness of 22 nm and mean diameter of 76 nm, rms roughness in the range of 17 nm, consistent with the requirement of sufficient smoothness to reduce scattering of light in the range of 300-400 nm.

MATERIAL REINFORCEMENT (TEXTILES)

➤ **High resistance textiles:** Using nanomaterials or nanocomposites it is possible to improve resistance and supply textiles with properties like fire-resistance or hydrophobicity.

i.e: : functionalised ZrO_2 and SiO_2 with silanes

APPLICATIONS OF TECNAN PRODUCTS IN SECURITY & DEFENSE

MISSILE DEVIATION

➤ **Modification of communication frequency:** Using innovative geometric patterns combining conductive and isolating materials.

i.e: ZnO/Au, mixed/doped nanoparticle of SnO₂/Pt, AZO/Ag

➤ **Yttrium Iron Garnet spheres (YIG spheres)** could also serve as magnetically tunable filters and resonators for microwaves frequencies.

➤ **Fake heat elements:** An specific coating could be activated over specifically located objects/element so that a sudden exothermic reaction is produced. Heat would be the result of a chain reaction where free radicals are involved.

i.e: TiO₂ NPs + organic matrices

APPLICATIONS OF TECNAN PRODUCTS IN SECURITY & DEFENSE

TECNADIS GWR

Hydrophobization of windscreens of security vehicles with the aim of improving the visibility.



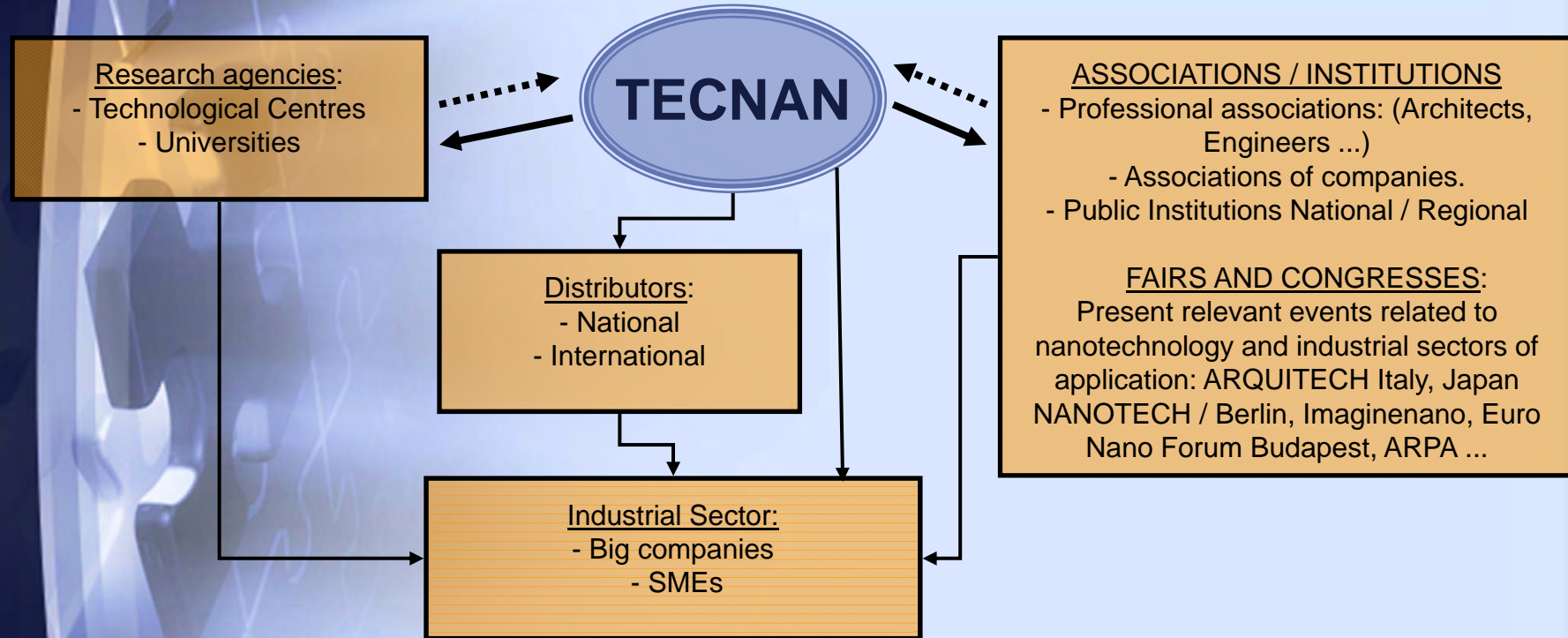
TECNADIS PRS EFFECT & TECNADIS PRS PERFORMANCE



TECNADIS PRS EFFECT:
Hydrophobization of facades of
military buildings.

TECNADIS PRS PERFORMANCE:
also supply with antigraffiti properties.

THIS IS HOW TECNAN WORKS



Ability to take on new challenges to develop new products tailored to customer specifications



AD-HOC SOLUTIONS

TECNAN is always close to its customers!

**LUREDERRA
TECHNOLOGICAL CENTRE**

(founder)

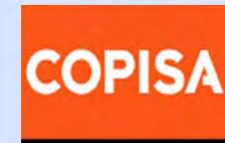
**50 RESEARCHERS
WORKING FOR TECNAN
S.L.**

GLOBAL MARKET



● Distribution offices

CLIENTS - COLLABORATORS



THANK YOU FOR YOUR ATTENTION!



“THINK BIG, ACT NANO”

Idoia Sancet

Industrial Applications

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