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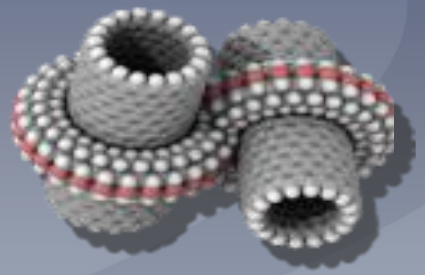
Measurement on nanomaterials and nanoproducts in industry

By Castañeda S. (CIDEC-Mx)

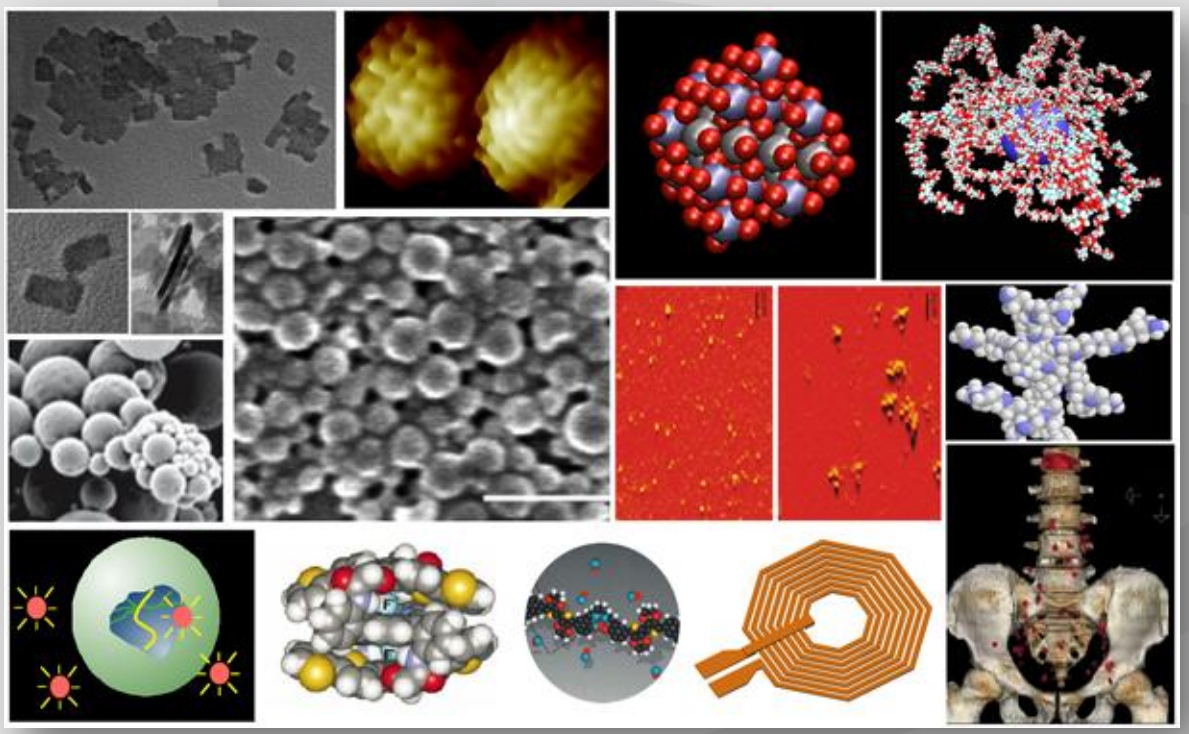
Present technological nanotechnologies revolution includes employment and/or production of nanomaterials and nanoproducts, which in turn request knowledge and quality demonstration of its manufacturing end products at nano scale.



Nanoproducts industrial production demands special attention regarding quality certainty of its end items

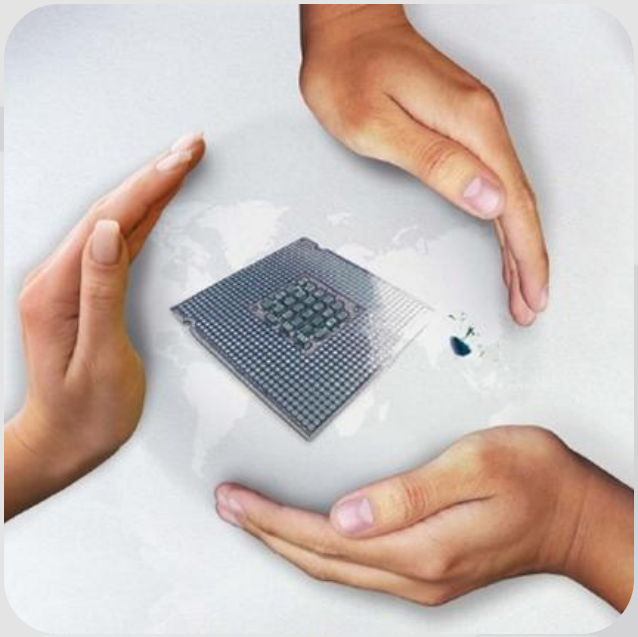
NANOTECHNOLOGY IN THE WORLD: PRESENT SITUATION

Present market has more than 10 000 products at global market level, considered as nanoproducts, or, at least one of their subassemblies .



Renowned world companies such as: Toyota, Boeing, General Motors, Volkswagen (to mention some), are developing Nanotechnology (or "Nanotech") as their product improvements.

Therefore, new companies are working in Nanotech such as NanoSys, Hybrid Plastics, Chemat Technology, Luxtera, Nano Devices, Cyrano Sciences, Genefluidics (among many others), where it is anticipated the employment of Nanotech and nanoproducts using practically knowledge areas of almost all exact sciences, impacting directly this industry, the global economy and the society.



To carry out this technological revolution, it is necessary to achieve technology transference (from research and university labs) towards mass production, that is:

Industrial Production of Nanoproducts

NANOTECH MASS PRODUCTION

In the present economy in order to get a new product in the business market, it is necessary to fulfill 3 fundamental topics:

- **Technical feasibility**
- **Comply regulations, specs and directives for its production and commercialization**
- **Yield**

CONDUMEX is a world-class industrial consortium, member of Grupo Carso. Currently, CONDUMEX activities focus on 5 business sectors: Automotive Parts, Cables, Electronics, Power and Integral Projects and Nacobre.

Condumex is aware of this technological revolution, as a company consortium that is distinguished by its technological innovation in all its business productive chains.

CONDUMEX, as a world-class Mexico's industrial consortium, it requires certainity in measurement of Nanotech, complying with minimum requeriments to demonstrate that a new development is in fact a Nanoproduct, with limitations in present equipment. For these reasons, it is very important to bear in mind two facts:

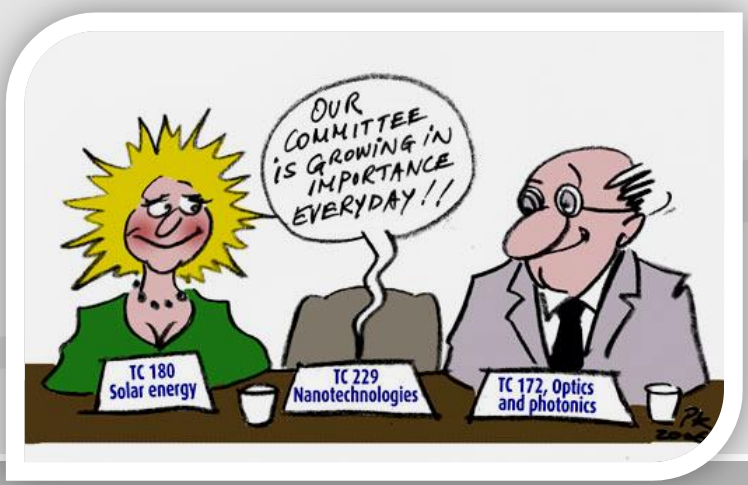
❖Small, medium and some large Mexico's and world's industrial companies do not posses the accurate (expensive) equipment for nanomaterials measurement.

❖Mexican industry requires correlations from nanomaterials measurement, focused and adapted to present industrial quality lab equipment (with limited capabilities).

REALITY IN THE INDUSTRIAL PRODUCTION

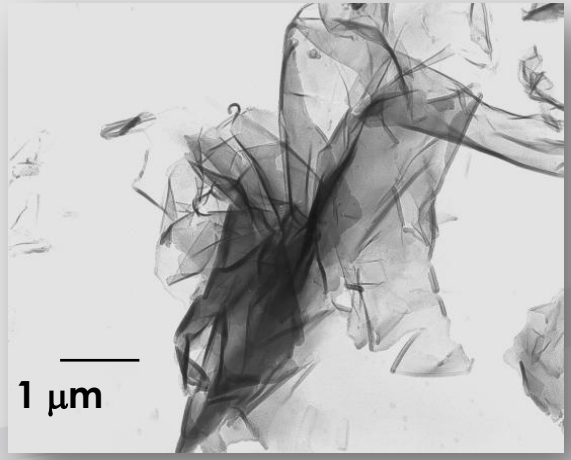
Mexican industrial production is governed under certain regulations depending on the requirements of the final client; also it always keeps in mind the vision that it must be a profitable business, optimizing its production tools and complying with the regulations that apply specifically for some processes and/or products .

The word: ***regulations***, opens the presence of following facts: Nowadays, there is an international Technical Committee (ISO TC/229), who is evaluating and preparing applicable regulations to Nanotechnology and to the different related areas related to this subject, being in Mexico the work group CT-13 "*Nanotecnologías*", which is a mirror group of this international committee.



Nevertheless, there are not yet some well defined regulations and products specs for all Nanoproducts that can be industrially produced, The absence of these regulations rises the need for the definition about *what is* and *what isn't* a nanoproduct, considering as a reference the sizing on International Metric System (SI) .

Combined to the previous paragraphs, also the majority of the industry in Mexico do not have the correct equipment for the measurement of magnitude in nano region in 1, 2 and 3 dimensions.



Nanoclay observed by TEM

TYPICAL ROUTE FOR MASS PRODUCTION

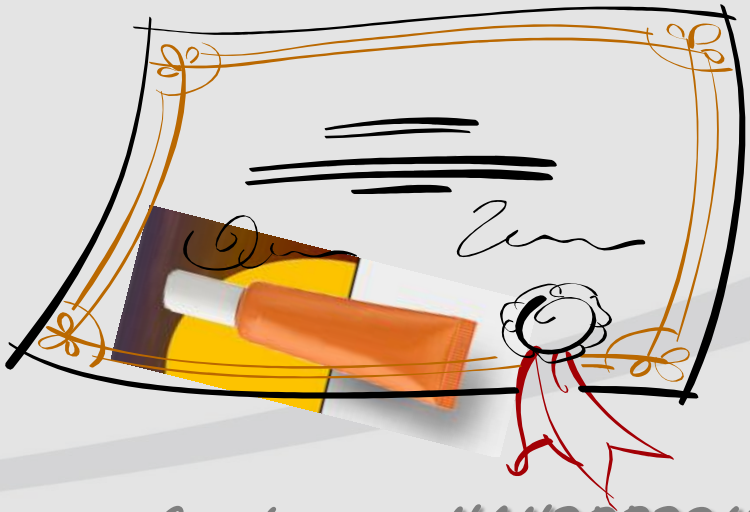
Mass production in almost all world industries, have the next general steps to achieve a final product:

- Search of raw materials and approval evaluation.
- Raw materials reception and evaluation (quality assurance)
- Integration of raw materials to the production process and process internal control .
- Final product is measured and evaluated by quality control (QC)
- Liberation of the end item with its origin certificate (being in this case a ***NANOPRODUCT***)

Representative illustration of mass production

Bearing in mind these last mentioned steps on the productive chain, the industry requires reliable techniques that can be employed with present equipment to correlate measurements , in order to confirm:

- Raw material, labeled material nano, ensuring it belongs to this classification.
- Process verification that the structure nano stays on the materials, at least in 1 (one) dimension .
- Certify that the yield product fulfills the minimal requirements to be considered a Nanoproduct



Autenticity Certificate as NANOPRODUCT

REQUIRED TECHNIQUES

As previously mentioned, Mexican industry does not own the technical resources to evaluate "*in situ*" nano materials characteristics and nanoproducts, yielding the reason for :

- Preparation of measurement techniques at nano level, that will be reliable and adaptable to internal quality controls in the industry with the current equipment, or maybe, the acquisition of relatively cheap equipment for these measurements.

- Developing skills of Quality Control personnel for a correct correlation of the values obtained in the measurements, with real values

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- As any measuring instrument, the calibration must be performed with certified materials as nanomaterials, elaborated by a reliable organization, and must be of easy acquisition

- Applied techniques must have a correlation with the values obtained by sophisticated techniques, at least 98% accurate, considering that these refined techniques have very low uncertainty values

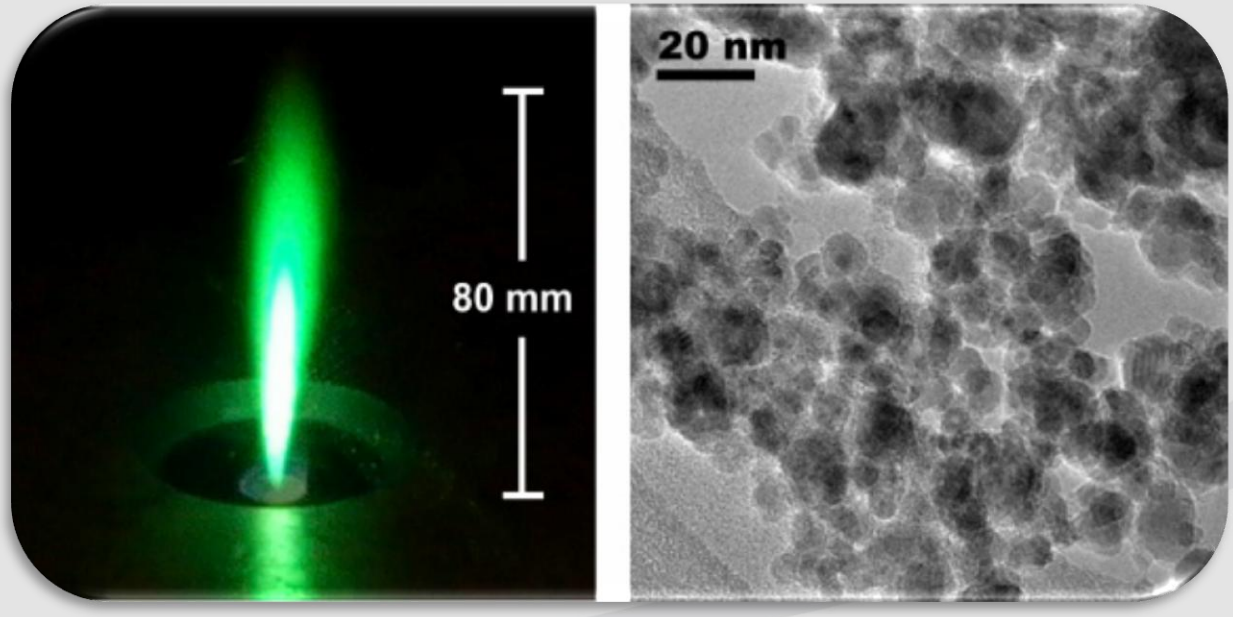
- For the elaboration of these techniques and their implementation, it is highly recommended that the Metrology Organizations deal directly with the needs of industry of North America (Mexico, USA and Canada)

CONCLUSIONS

In a practical way, manipulation of materials denominated as nano is not performed atom by atom, but in a higher dimension, that is, all the nanomaterials are deposited in such a way that serve as a support being capable to manipulate them, which forms the basis for their industrial manipulation.

In order to demonstrate to the effectiveness of materials nano, it is very important to demonstrate unique properties attributable to nanomaterials including reinforced materials and to test their dimensions in the nano region.

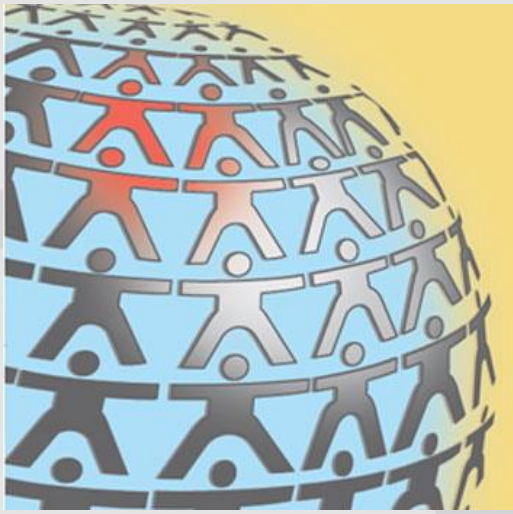
Correlation of measurements in materials nano is feasible due to its unique characteristics on its catalytic, mechanical, magnetic, and thermodynamic properties and semi conductivity in some cases.



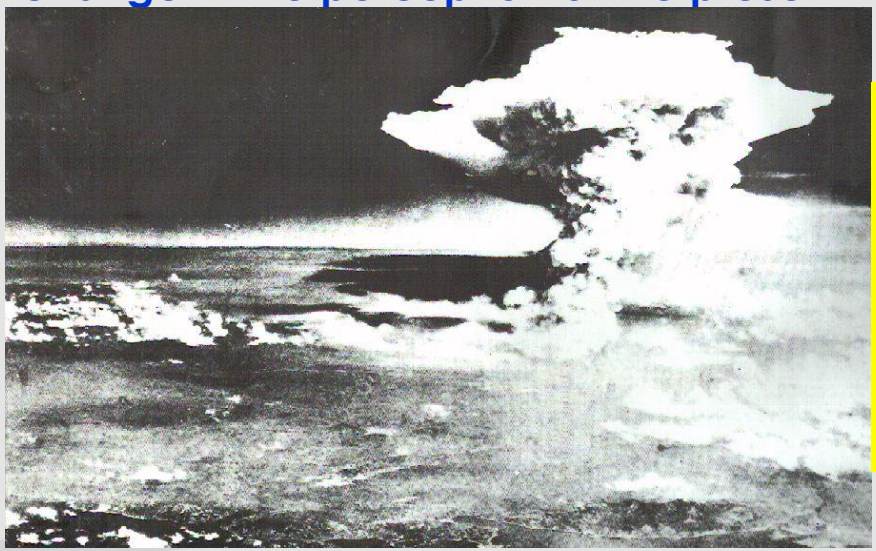
Reducing flame synthesis gave access to carbon coated copper nanoparticles with special electrical properties enabling their use for most important sensor applications.

COMMENTS

Nanotech is not an objective itself, nor is an academic curiosity, it is a path to achieve diverse objectives that at present days are not feasible yet.

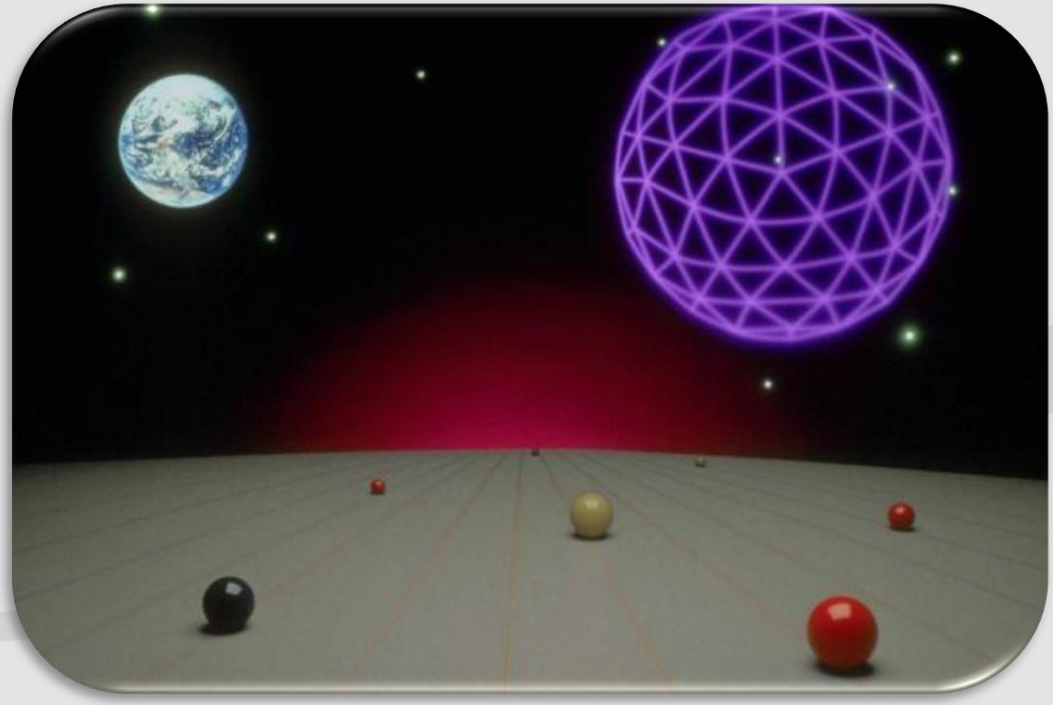


Real life applications are currently in: medicine, agriculture, engineering, chemistry, physics, computer science, robotics, etc., which will all have important society impacts, since it is a change in the perception of the present world.



The dark side of this new discipline is the use of these technologies for warfare, bringing impressive advances, but also with catastrophic results for the humanity.

On the basis of the last comment, it arises the concept of Responsible Nanotechnology, whose objective is to watch over the suitable use of this science, that is, additional to the correlation techniques and industrial applications with pacific and productive aims, it is necessary to keep in mind the concept of **RESPONSIBLE NANOTECHNOLOGY.**



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THANK YOU FOR YOUR ATTENTION

ABOUT THE AUTHOR

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Along with another investigators, is one of the winners of "*Urbain J.H. Malo Memorial Medal Award, in the Electrical division*" for 2008, by paper, "Performance of nanoclay in a flame retardant jacket compound", being this one of the first publications of nanotechnology for industrial application