

**A WIDELY  
KNOWN & USED  
BUT IGNORED  
GIANT  
NANOSTRUCTURE**

## **MOST NANO-SCIENTISTS WORK ON**

- Nanostructures & their unique properties
- How to make, characterize and understand them
- Develop products based on them...and so on

## **HOWEVER, VERY FEW THINK/WORK ON**

- Destruction, conversion or modification..etc...of nanostructures
- **Products that can be developed by destroying, converting, modifying....etc of nanostructures**

## CAN WE SEE A NANO-STRUCTURE WITH NAKED EYES?

- $1 \text{ nm} = 10^{-9} \text{ meter} = 1/1,000,000,000$  of a meter  
How to see an object which is  $\sim 50,000$  times thinner than a human hair?

## CAN A NANO-STRUCTURE BE A GIANT OBJECT?

How a nano-structure be a giant?

- Not only one can see a nano-structure with naked eyes but it can be a giant structure as well. You have not only seen but used such a nanostructure as well
- It is a metal/aluminum layer on a metallized plastic film

# CAN WE SEE A NANO-STRUCTURE WITH NAKED EYES?

- 1 nm =  $10^{-9}$  meter = 1/1,000,000,000 of a meter  
How to see an object which is ~50,000 times thinner than a human hair?

## CAN A NANO-STRUCTURE BE A GIANT OBJECT?

- You have seen and used at least one such a nanostructure. It is a metallized plastic film/bag



# METALLIZED PLASTIC FILMS

- Do you know the thickness of the aluminum layer of a metallized plastic film? **Typically it is only 100 Angstroms thick (i.e., 10 nanometers)**



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# METALLIZED PLASTIC FILMS

- Do you know the thickness of the aluminum layer of a metallized plastic film? **Typically it is only 100 Angstroms thick (i.e., 10 nanometers)**
- **Do you know what 10 nm thick mean? Thickness of the aluminum layer is about 5,000 times thinner than the plastic film it is coated on, equivalent to a sheet of paper over 10 reams (5000 sheets) of paper!!**



Aluminum is a very flammable metal. **A thin (e.g., 10 nm) layer of aluminum reacts with oxygen on the surface in a nanosecond to form a highly protective oxide layer**

A diagram illustrating the structure of an aluminum layer. It consists of two horizontal rectangular regions. The top region is a thin white layer, and the bottom region is a much thicker gray layer. The text '~1-2 nm Oxide layer' is centered within the white layer, and '~10 Aluminum layer' is centered within the gray layer.

~1-2 nm Oxide layer

~10 Aluminum layer

We see the 10 nm aluminum layer because metals are most opaque materials and the layer is two dimensional. We don't see the same sized oxide layer because it is essentially transparent like glass



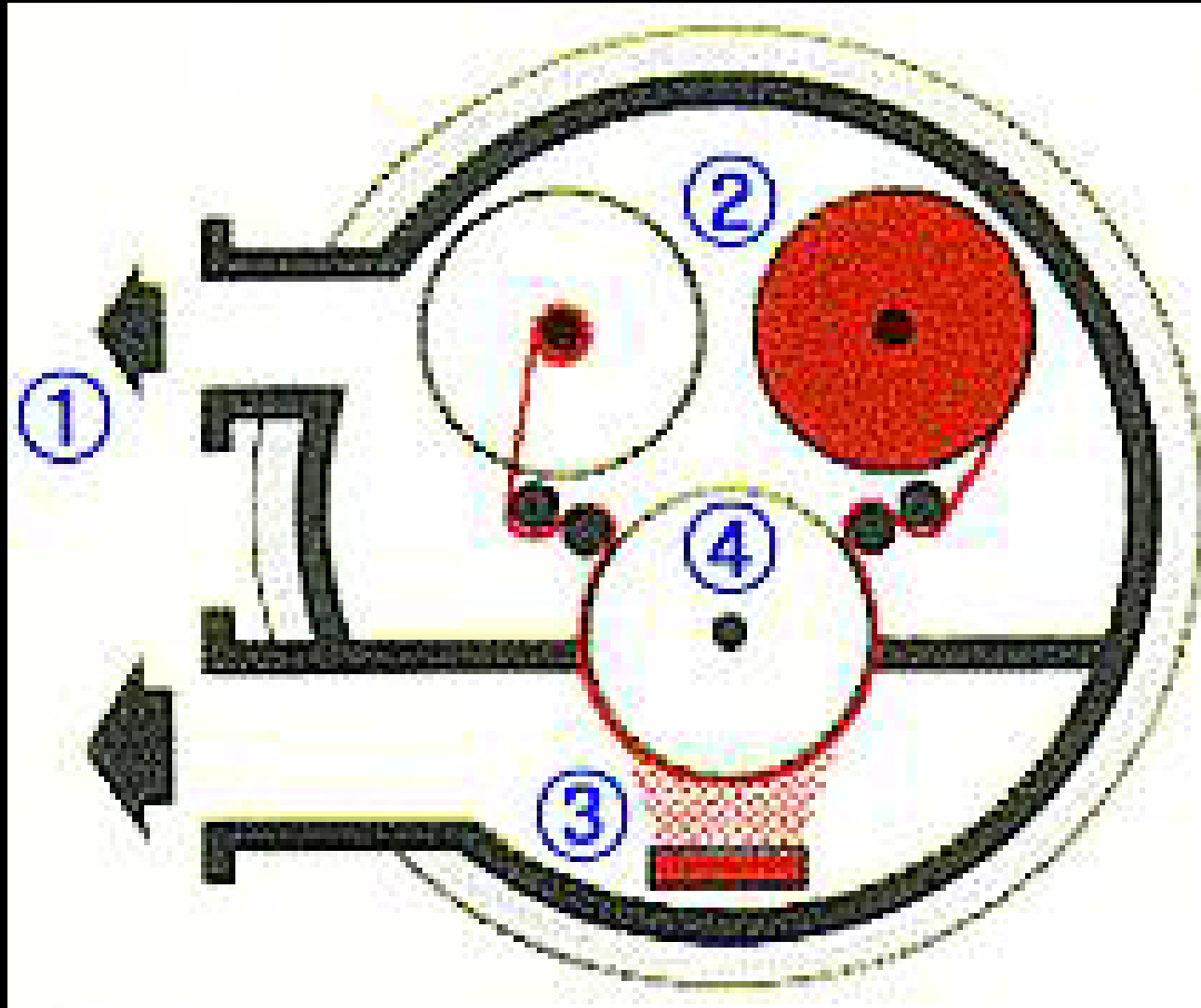
~1-2 nm Oxide layer

The diagram consists of a vertical rectangle divided into two horizontal sections. The top section is a thin white layer, and the bottom section is a much thicker gray layer.

~10 Aluminum layer

# HOW METALLIZED PLASTIC FILMS ARE MADE

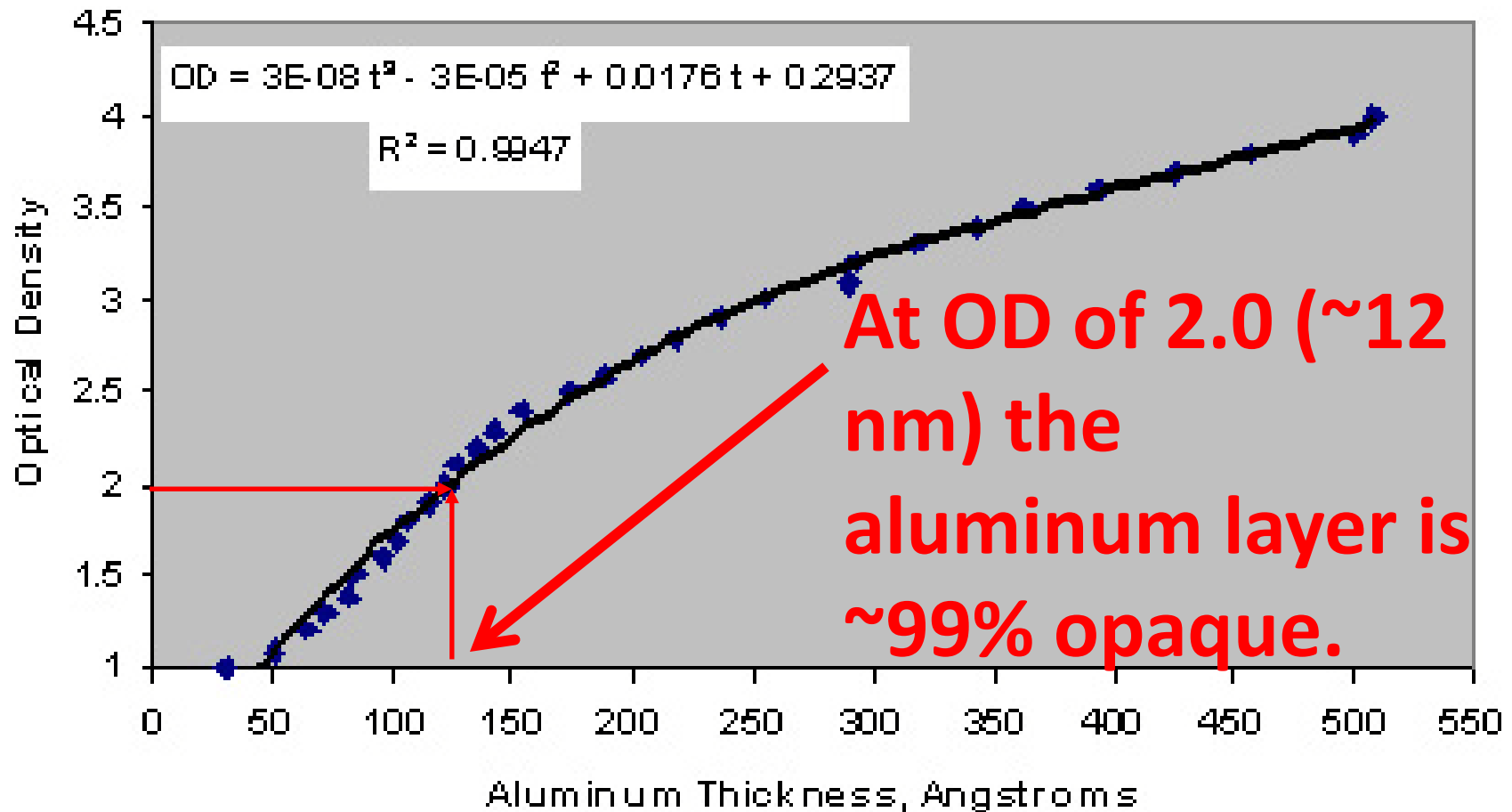
## Vacuum Metallization



1.Vacuum Pump , 2.Winder: Winds and releases film. 3.Vaporizer : Evaporate metal material for metallization. 4. Cooling Drum

# METALS ARE THE MOST OPAQUE MATERIALS

Optical Density as a Function of Aluminum Thickness of a Metallized Film (Data from Schan<sup>3</sup>)



**ARE THE ALUMINUM  
AND ITS OXIDE LAYERS  
OF A METALLIZED  
PLASTIC FILM TWO  
DIMENSIONAL  
NANOSTRUCTURES?**

# SOME WIDELY ACCEPTED DEFINITIONS

- “...Nanotechnology is the understanding and control of matter at dimensions between approximately 1 and 100 nanometers, where unique phenomena enable novel applications. ...” “...Nanofilms or nanoplates have a thickness that’s nanosize, but their other two dimensions can be quite large. ..” NNI and NSF <http://www.nano.gov/html/facts/faqs.html>
- “....Generally nanotechnology deals with structures of the size 100 nanometers or smaller in at least one dimension, and involves developing materials or devices within that size. ....”  
<http://en.wikipedia.org/wiki/Nanotechnology>

# DEFINITION ACCORDING TO US PTO

US Patent and Trademark office defines nanostructures as:

- "...“nanostucture" is defined to mean an atomic, molecular, or macromolecular structure that:
- (a) Has at least one physical dimension of approximately 1-100 nanometers; and
- (b) Possesses a special property, provides a special function, or produces a special effect that is uniquely attributable to the structure s nanoscale physical size. ....”

<http://www.uspto.gov/web/patents/classification/uspc977/defs977.htm>

# METALLIZED PLASTIC FILM

- The thicknesses of aluminum and its oxide layer of most of the commercially available metallized plastic films are between 2-70 nm (typically 10 nm) and between 1-3 nm respectively.
- As shown on this website they display uncommon, novel and unique properties, including a large number of equally novel and unique applications which can be attributed to 2D-nanostructures only.
- **ACCORDING TO THE ABOVE AND OTHER DEFINITIONS, THE ALUMINUM (VISIBLE) AND ITS OXIDE (INVISIBLE) LAYERS OF A METALLIZED PLASTIC FILMS ARE NOT ONLY TWO DIMENSIONAL NANOSTRUCTURES BUT GIANT NANOSTRUCTURES**

# NANO CONVERSION TECHNOLOGY

- We envisioned and developed a large number of products based on destruction of nanostructures and have demonstrated feasibility of the concepts for a number of others (USP Application # 20090301382 and other applications pending)
- In the other files we show some examples of unique indicators we developed by destruction of just a couple of nanostructures limited to only one material; ~10 nm metal (aluminum) layer and its naturally formed ~2 nm oxide layer on a plastic film
- **Other products based on destruction of other nano-structures will be announced later on**

# **NANO-INDIST™**

## **A REVOLUTION IN INDICATOR TECHNOLOGY**

**NOVEL & UNIQUE PRODUCTS  
WITH NOVEL & UNIQUE PROPERTIES  
BY DESTRUCTION OF NANOSTRUCTURES**

# NANO-CONVERSION TECHNOLOGY

AN IGNORED BUT NOVEL AND  
UNIQUE FIELD OF NANOSCIENCE

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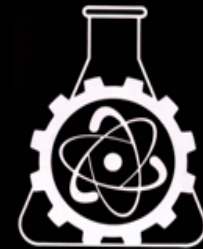
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Nano-Conversion  
Technology