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Labeling Nanotech-enabled Products to Advance Social Responsibility

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Outline

- Why Labeling
- Taiwan nanoMark System
- APEC Collaboration on Nano Measurement
- International & Regional Activities on Nano Metrology

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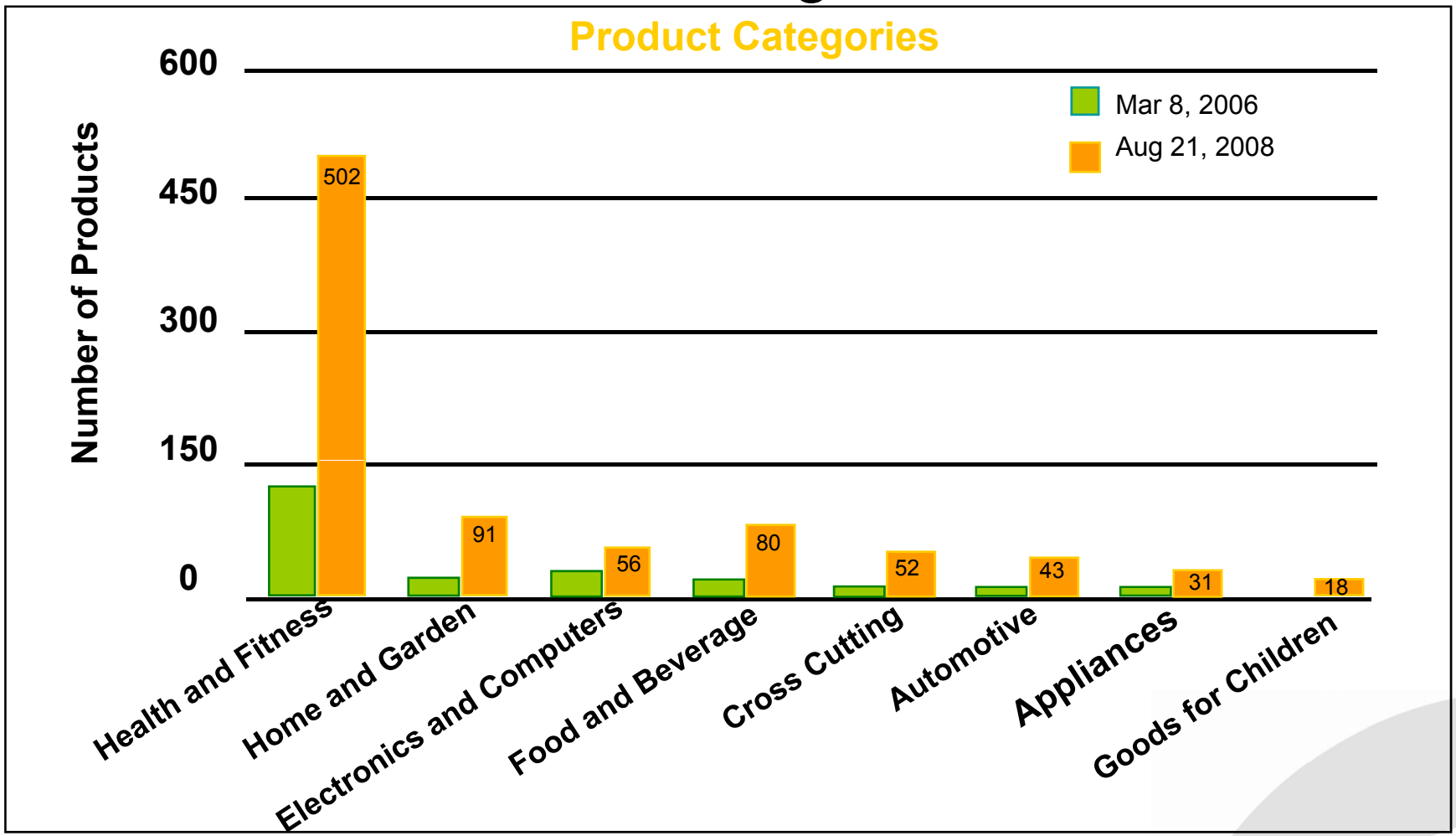
More & More Nanotech-enabled Products Entering the Market



Number of products from 21 countries : 212 (2006/03/08) → 803 (2008/08/21)

- **Paint is a sub-category under Home and Garden**
- **Display is a sub-category under Electronics and Computers**
- **Cross Cutting is a grouping of multi-functional products, e.g. coating**

Source：http://www.nanotechproject.org/inventories/consumer/analysis_draft/

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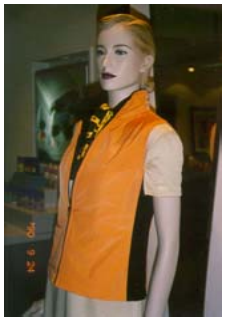
Why Labeling



















With Nano, product price could be skyrocketed by more than ten times!

Are They Real Nano-enabled Products?

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Why Labeling

- **Protect Consumers : Avoid waste money**
- **Protect Good Companies : Eliminate unfair competitions between good and bad products**
- **Increase Public Trust : Facilitate healthy development of nanotechnology**
- **Facilitate Trade : Stimulate economic growth**

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Advance Social Responsibility

Approaches： **Focus on Consumer Products**

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How to Choose which Products to Have nanoMark ?

- **Impossible to certify all commercial nanoproducts**

  ⇨ **Specification / Testing Methods are not all ready**

- **How to choose ?**

  - **Product Commercialized ? Capable Testing Labs ? Testing Methods ?**
  - **Prudent with Risk Potential Products, e.g. cosmetics**
  - **Producers could suggest items provided enough information is ready**

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Requirements

- **Basic Requirements**
  - **— Nano Scale (in principle, < 100nm)**
  - **— Unique Properties**
- **Quality System Installed**
- **Safety Issues being taken care / Traceable Products**
- **Contract to use “ nanoMark”**

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Example
— photocatalyst (UV & Visible light) Anti-bacterial Tiles

- **How many bacteria have to be tested ?**
  - ✧ **Representative**
  - ✧ **Safe / easy to handle**

  } ⇨ ***Staphylococcus aureus*** **: ATCC 65389, BCRC 10451**
  Escherichia Coli **: ATCC 8739, BCRC 11634**

- **How effective anti-bacterial tiles should be ?**
  - ✧ **achievable**
  - ✧ **Testing Protocol (conditions, raw materials and/or final products)**
  - ✧ **Top 50% Companies**

  } ⇨ **> 90%**

- **What should be specified on the product package ?**
  - ✧ **How to use**
    - **where**
    - **who**
    - **how (application methods, maintenance, etc.)**
  - ✧ **Reliability**

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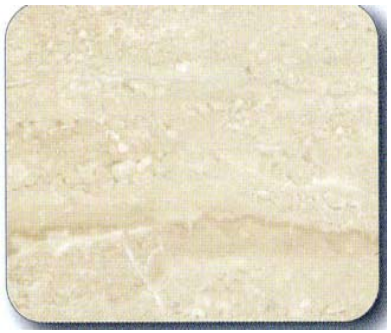
Example
— photocatalyst (UV & Visible light) Anti-bacterial Tiles

Tiles：N041 (900mm x 1800mm) (CERABO)
N04590 (450mm x 900mm) (Ohayo)

Who：Construction Companies, General Publics
Where：Indoor (e.g.. toilet), Outdoor
How：• Adhesion to fix on the substrate
• Wet cloth to wipe if dirty
Reliability：real case (> 3 years)

Wall Tile (45 x 90 cm)



Floor Tile (90 x 90 cm)

Test：
Nano Scale：raw material, 40nm
Product, confirmed to have TiO_2

Anti-bacteria：	***S. aureus***	**99.99%**	**365nm UV, 0.2mW/cm² / 24 hrs**
	E. Coli	**99.99%**	
	S. aureus	**99.99%**	**543nm, 1000 lx / 24 hrs**
	E. Coli	**97.83%**	

Quality System：ISO9001 (Certification：4XBY008-04)
Safety Issue：CNS 3298

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Advance Social Responsibility -- Since 2004

Nano-enabled Products	Criteria				
	Nanoscale	Unique Properties		Safety Issues	Others
		Specified Properties	Reliability		
Photocatalyst Products • anti-bacterial tiles	Photocatalysts & Products	• anti-bacteria >90%			• meet national standards • equal or better than the industrial standards
• anti-smudgy tiles		• CA <10°; CA (dark/48hr)<30 ° • methylene blue de-color <1hr	• 3% salt water, 96hr • 5% H_2SO_4/24hr • 5% Na_2CO_3/24hr		
• deodorized paints		• de-odor (acetaldehyde >70%)			
• anti-smudgy paints		• CA : 30°(<5hr) ; CA (dark/48hr)<30° • methylene blue >70%, 6hr			
• anti-bacterial light tubes		• anti-bacteria >90%			
• air cleaning light tubes		• acetaldehyde ≧ 2mmol/kW•h • toluene ≧ 0.05mmol/kW•h			
• air purifiers and filters		• purifier : de-NO>60% filter : de-acetaldehyde >70%			

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Advance Social Responsibility -- Since 2004 (con.)

Nano-enabled Products	Criteria				
	Nanoscale	Unique Properties		Safety Issues	Others
		Specified Properties	Reliability		
Hydrophobic Surface	Product Surface Structure				• meet national standards • equal or better than the industrial standards
• anti-smudgy sanitary facilities • anti-smudgy metal partition		• CA >100 ° • simulated dirt <1%	• anti-brush (2000 times)		
• anti-smudgy household exhaust hood		• CA >100 ° • vegetable & animal oil adhesion <90%	• anti-brush (500 times) • heat resistance (100℃/8hrs)		
• hydrophobic car wax		• CA >100 ° • water roll angle <30° • water blot <10%	• anti-soap wash (1000 times)		
Anti-abrasive Products • anti-abrasive PU resins & synthetic leathers	Nanoparticle & products	• anti-abrasion 50% higher than the originals (Taber test)			
• anti-abrasive bicycle seat		(under developing)	(under developing)		
Nano-silver Products • anti-bacterial marble	Nanosilver & products	• anti-bacteria >90% • hardness maintain • glossness ≥ ±1.5GS	anti-abrasion (5000 times) anti-brush (520 times)		
• anti-bacterial household textile		• anti-bacteria >90%	anti-wash 10 times		
• anti-bacterial socks		• anti-bacteria >90%	anti-wash 20 times	• skin irritation test <2 • oral acute toxicity test	

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Some Observations of nanoMark Impact to Industry

- **With nanoMark, Less Advertisement Expenses**
- **Second-tier Companies ⇨ First-tier**

Anti-smudgy paints	Nano Scale	Decomposed Rate (methylene blue)	Hydrophilic Test	
			CA30° (Time)	Contact Angle (48hrs in Dark)
Company A	TiO2, Anatase 5.3nm (XRD)	61%/6 hrs	2 hr	46
Company B	TiO2, Anatase 5.6nm (XRD)	75%/6 hrs	2 hr	20

- **Accelerate Infrastructure-establishing**
  - **Test Methods**
  - **Test Labs ⇨ Service Sector**
- **Initiate Self-regulated Marks**

nano coating

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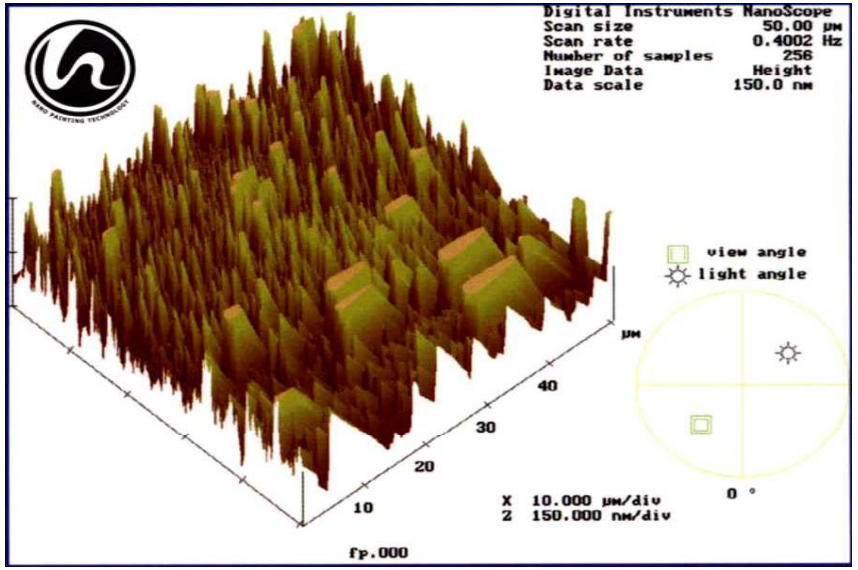
Self-clean Coating



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APEC Collaboration on Nano Measurement

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Regional Activities

— Nano Measurement on Particles Size & Film Thickness

APEC ISTWG Project

"Technological Cooperation Framework on Nanoscale Analytical and Measurement Methods"

Host economy：Chinese Taipei

Co-sponsors：Australia, Canada, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand, United States, Vietnam

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Why Cooperation

❖**Characterization Tools:**

Many ⇨ **How to choose**

Expensive ⇨ **Can't get all**

❖ **Nanoscale Analytical and Measurement Technique:**

⇨ **need experienced people**

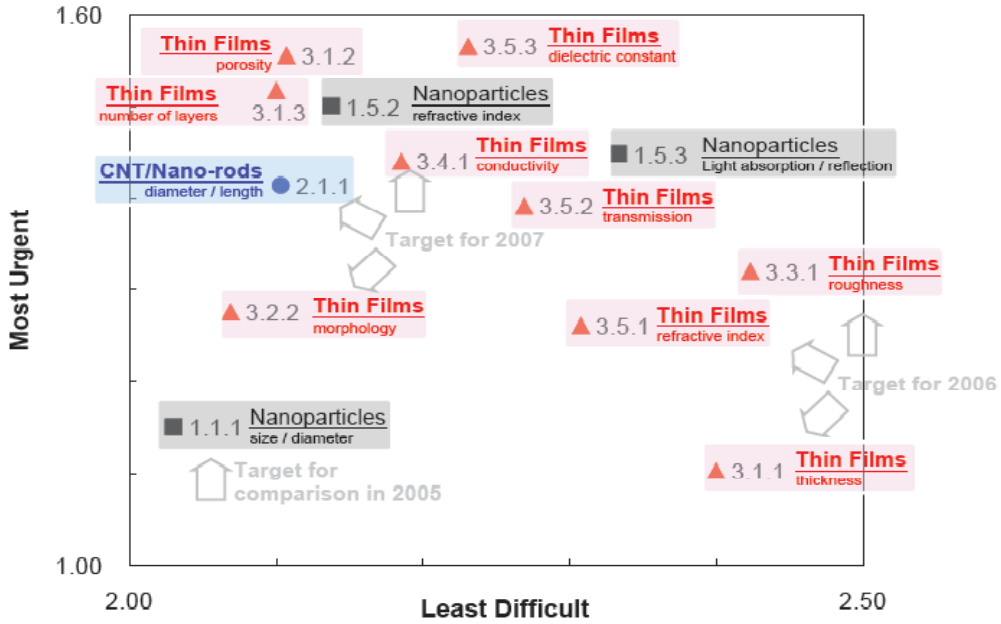
❖ **For Trade:**

⇨ **International trade agreements demand demonstrated equivalence between the measurement standards of buyer and seller nations.**

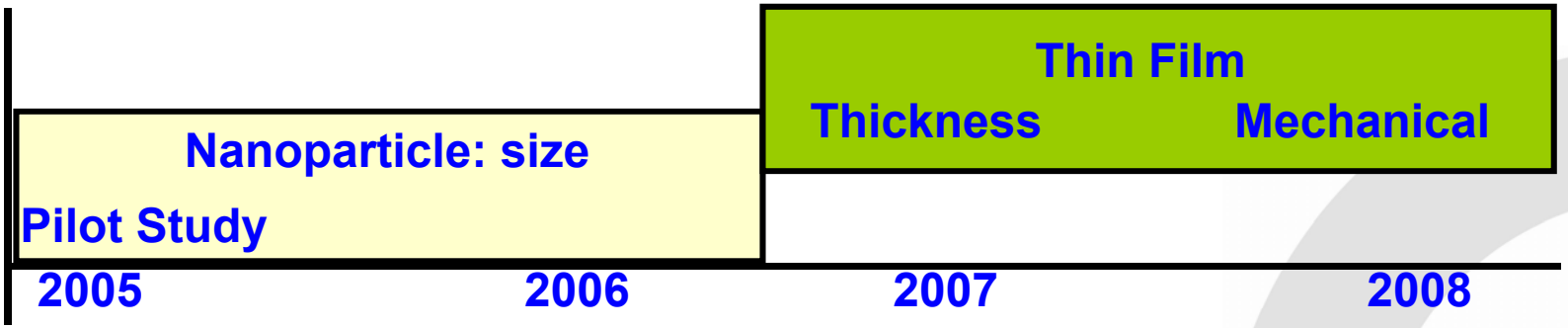
- **Shorten developing time**
- **Develop human capability**
- **Base for mutual recognition among Economies**

How to Choose the Measurement Items

■ 2005：Three-year Roadmap
（Urgency vs. Difficulties）



■ Considering Availability of Measurement Samples ⇨ Nanoparticle, Thin film



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Objectives and Methodology

❖ **Establish a Technological Cooperative Framework**

- **Interlab Comparison**

❖ **Provide a Unique Avenue to Share Most Recent Advances on Nanometrology**

- **Nanoscale Technological Forum, Hand-on Workshop**

- **Identify and Promote the Best Available Technologies in Nanometrology**
- **Contribute to strengthen the free trading system in APEC region**

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What Have Been Done

Sample：2005：PS Latex CRM（100, 20nm）, Nano-silver（20nm）

2006：PS Latex CRM（100, 50, 30nm）

2007：SiO_2 reference thickness (2,5,10nm)

2008：Fused Silica and Polycarbonate

Instruments

- **Diameter measurement： DLS, SPM, SEM, TEM, DMA**
- **Thin film thickness： SE, TEM, XPS, XRR, XRF**
- **Mechanical properties：Nano-indentation**
  (MTS, Hysitron, UMIS, CSM, MICRO MATERIALS)

Participants：2005：10 labs (w/o 2 withdrawals)/ 6 Economies（Australia, China, Japan, Mexico, Chinese Taipei, USA）

2006：16 labs (w/o 4 withdrawals)/ 10 Economies (Australia, Canada, China, Hong Kong, Japan, Mexico, Philippines, (South Africa), Chinese Taipei, Thailand)

2007：15 labs/ 11 Economies (Australia, Canada, China, Hong Kong, Japan, Mexico, Philippines, Chinese, Taipei, Thailand, US, Italy)

2008：16 labs/ 8 Economies (Australia, China, Korea, Malaysia, Mexico, Philippines, Thailand, Chinese Taipei)

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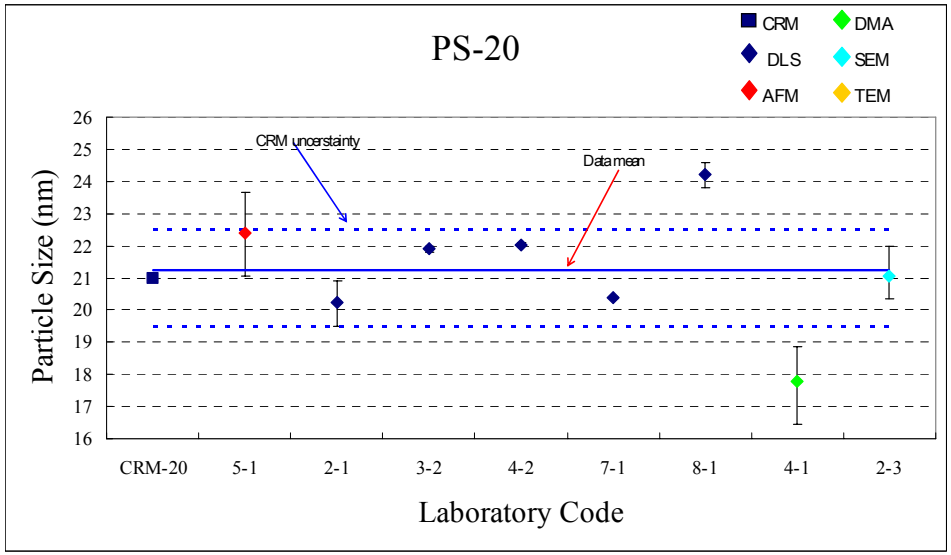
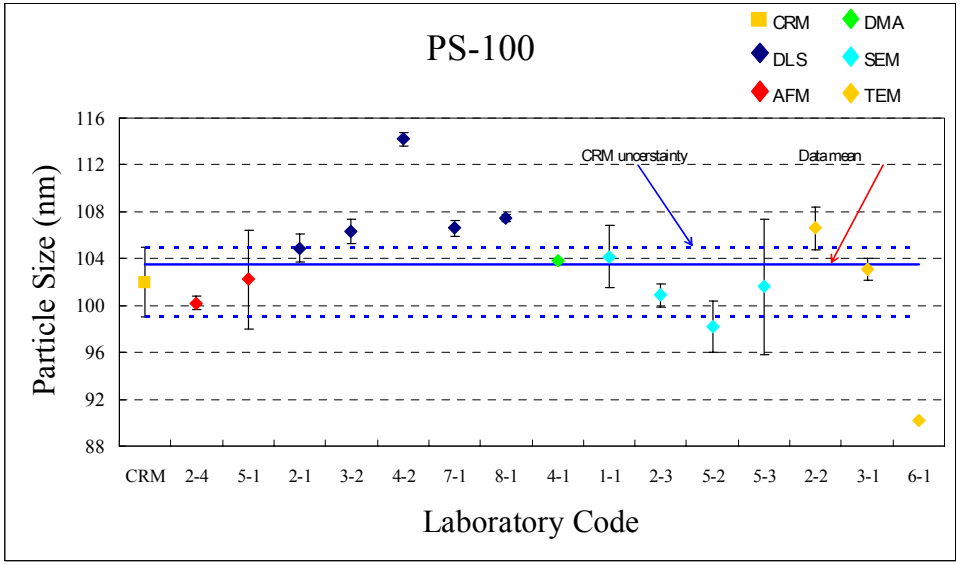
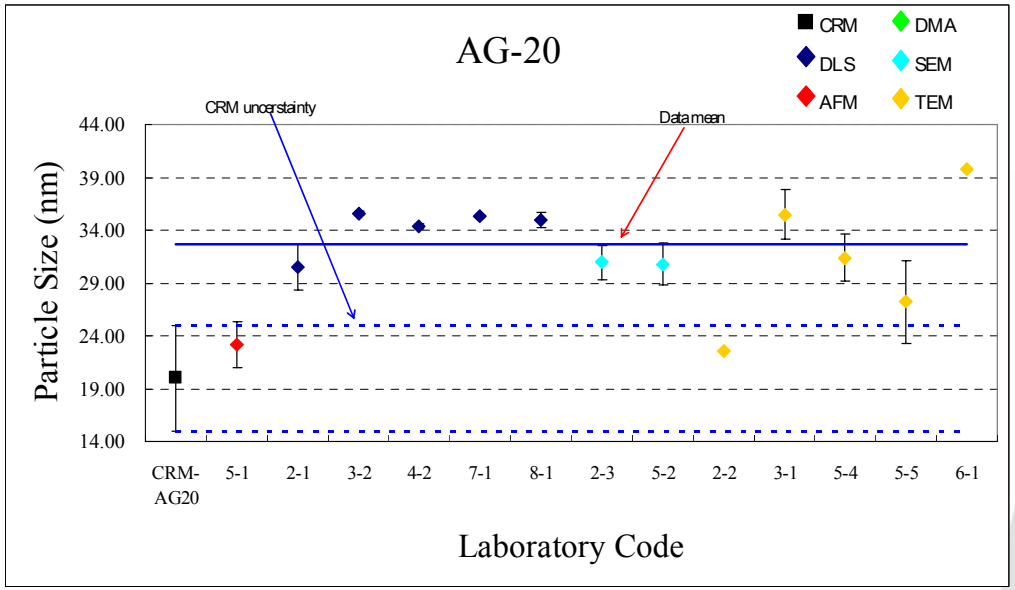
What Have We Learned

2005 : • The Smaller the Size, The Larger Scattering the Measurement

• Shape Matters







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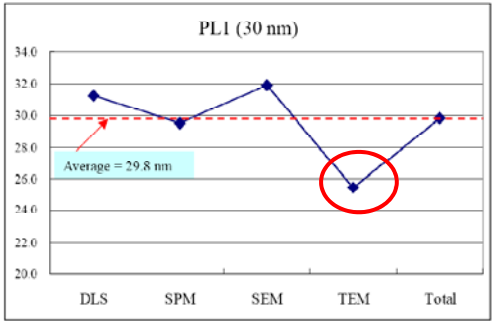
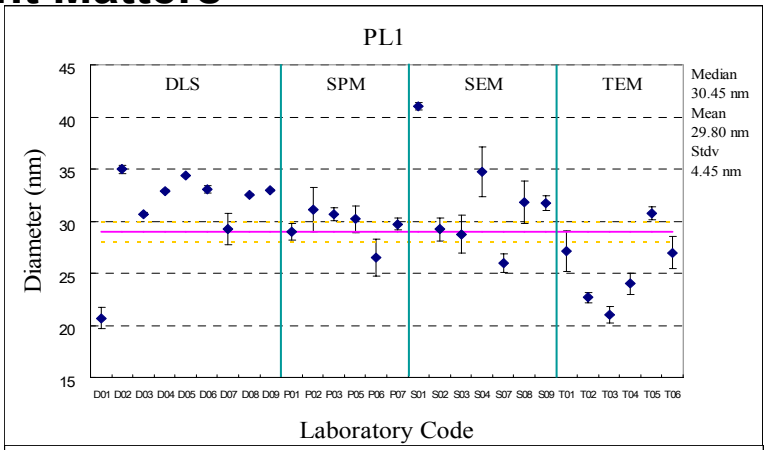
What Have We Learned

2006 : Instrument Matters

PL 1 (30 nm)-- Certified Value: 29 ± 1 nm

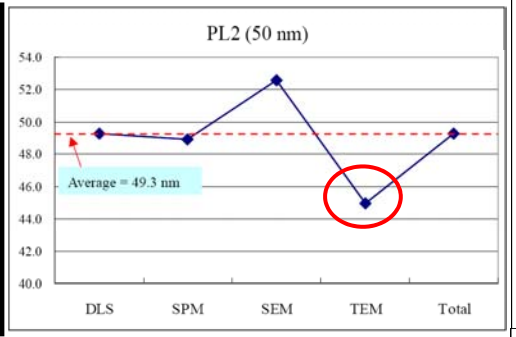
PL1	DLS	SPM	SEM	TEM	Total
Mean	31.3	29.5	31.9	25.4	29.8
Stdev	4.3	1.7	4.9	3.5	4.5
Minimum	20.7	26.5	26.0	21.1	20.7
Median	32.9	30.0	31.7	25.5	30.4
Maximum	35.0	31.1	41.0	30.8	41.0
Range	14.3	4.6	15.0	9.7	20.3

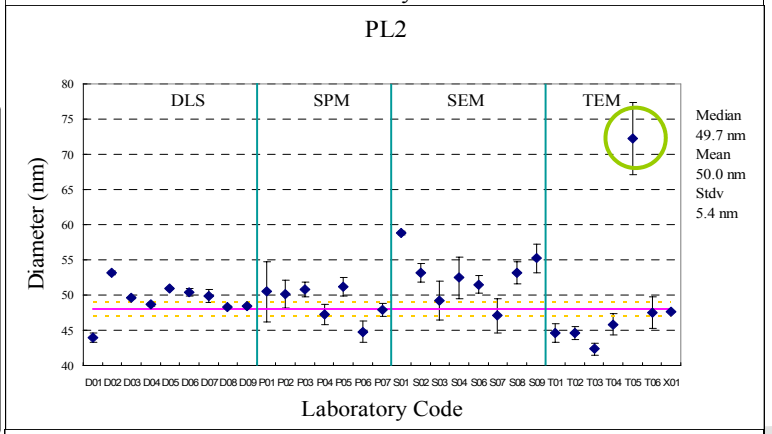




PL2 (50 nm)-- Certified Value: 48 ± 1 nm

PL2	DLS	SPM	SEM	TEM	Total
Mean	49.3	48.9	52.6	45.0	49.3
Stdev	2.5	2.4	3.6	1.9	3.6
Minimum	43.9	44.8	47.1	42.3	42.3
Median	49.7	50.2	52.8	44.7	49.4
Maximum	53.2	51.2	58.8	47.5	58.8
Range	9.2	6.4	11.7	5.2	16.5

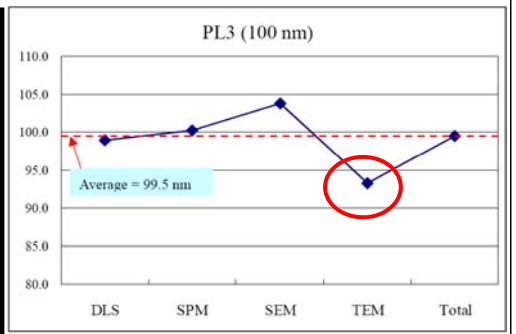


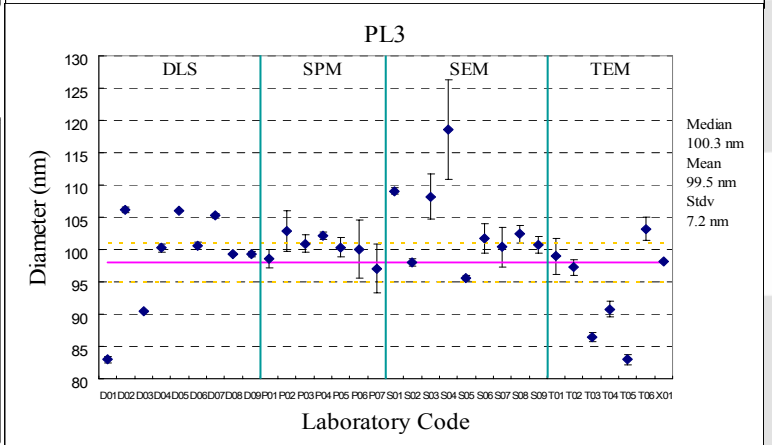


Calculated Results excluding outlier

PL3 (100 nm)-- Certified Value: 100 ± 3 nm

PL3	DLS	SPM	SEM	TEM	Total
Mean	98.9	100.3	103.9	93.3	99.5
Stdev	7.7	2.0	7.0	7.8	7.2
Minimum	83.0	97.1	95.6	82.9	82.9
Median	100.3	100.3	101.8	94.0	100.3
Maximum	106.2	102.9	118.6	103.2	118.6
Range	23.2	5.8	23.1	20.3	35.7





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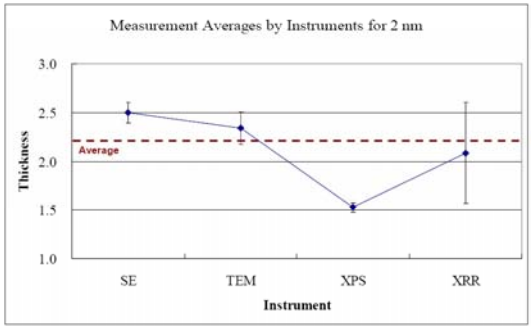
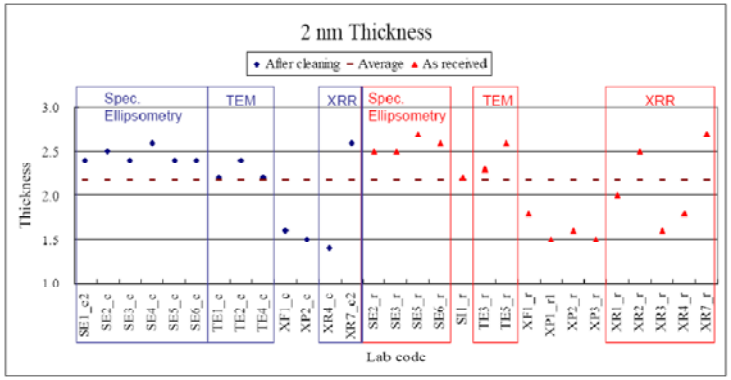
What Have We Learned

2007 : • Cleaning Method Makes Difference
• Instrument Matters

TK02 Series- 2 nm SiO2 Thickness

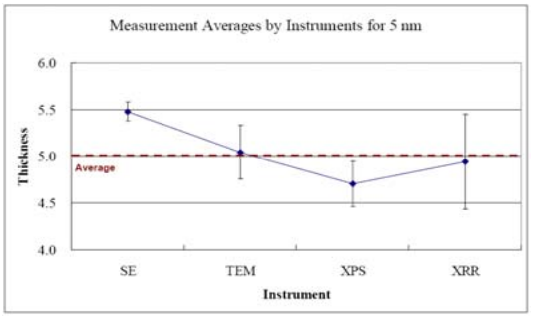
TK02 Series	SE	TEM	XPS	XRR
Mean	**2.5**	**2.3**	**1.5**	**2.1**
Stdv	**0.1**	**0.2**	**0.1**	**0.5**
Minimum	2.4	2.2	1.5	1.4
Median	2.5	2.3	1.5	2.0
Maximun	2.7	2.6	1.6	2.7
Range	0.3	0.4	0.1	1.3
Number of samples	10	5	4	7

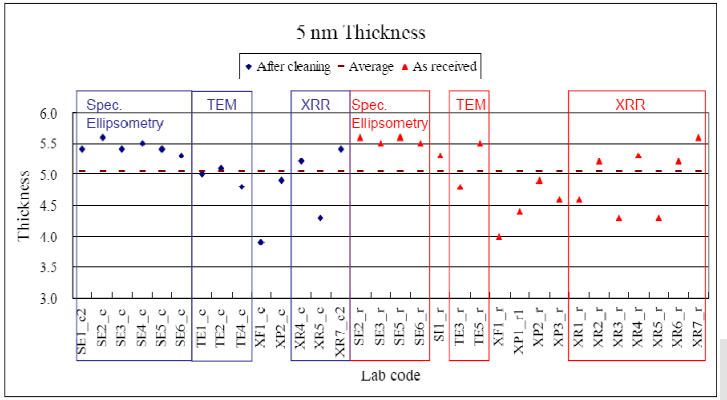




TK05 Series- 5 nm SiO2 Thickness

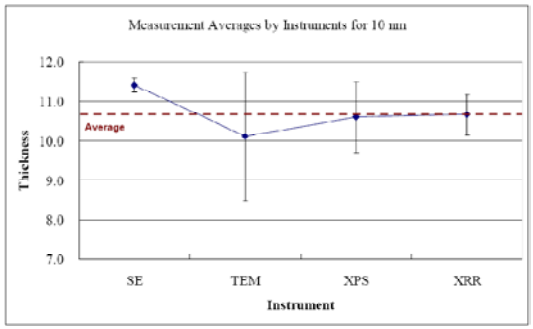
TK05 Series	SE	TEM	XPS	XRR
Mean	**5.5**	**5.0**	**4.7**	**4.9**
Stdv	**0.1**	**0.3**	**0.2**	**0.5**
Minimum	5.3	4.8	4.4	4.3
Median	5.5	5.0	4.8	5.2
Maximun	5.6	5.5	4.9	5.6
Range	0.3	0.7	0.5	1.3
Number of samples	10	5	4	10

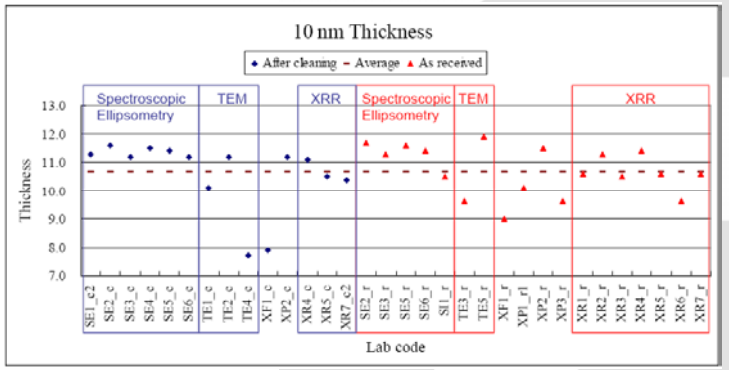




TK10 Series- 10 nm SiO2 Thickness

TK10 Series	SE	TEM	XPS	XRR
Mean	**11.4**	**10.1**	**10.6**	**10.7**
Stdv	**0.2**	**1.6**	**0.9**	**0.5**
Minimum	11.2	7.7	9.6	9.6
Median	11.4	10.1	10.7	10.6
Maximun	11.7	11.9	11.5	11.4
Range	0.5	4.2	1.9	1.8
Number of samples	10	5	4	10





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International and Regional Activities

	Global Organizations			Regional Organizations			U.S. Organizations			Other ISO
	ISO TC229	IEC TC113	OECD	CEN TC 352	APEC	ANF	IEEE	ANSI-NSP	ASTM E56	ISO TC 24, 35, 164, 201, 213
Terminology	X	X	X	X		X		X	X	X
Basic metrology	X	X			X	X		X		X
Instruments test methods, characterizations	X	X				X		X		X
Particle measurements, characterizations					X	X			X	X
Dimension measurements, characterizations	X				X	X			X	X
Physical characterization	X				X	X		X	X	X
Chemical characterization	X					X				
Environmental, health and safety	X		X	X		X		X	X	
Test methods for toxicity	X		X	X		X		X	X	
Risk evaluation	X		X	X		X		X	X	
Societal impacts, Regulatory frameworks			X							
Materials or Products	X	X			X	X	X	X	X	
Materials specifications (CNT & others)	X	X				X	X	X	X	
Materials specifications (reference standards)						X				
Manufacture processes										
Certification, performance assessment		X				X				