



Nanostellar Inc.

Clean Technology Nano Materials for Emissions Control

Pollution Prevention Through Nanotechnology

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This document provides an outline of a presentation and is incomplete without the accompanying oral commentary and discussion.

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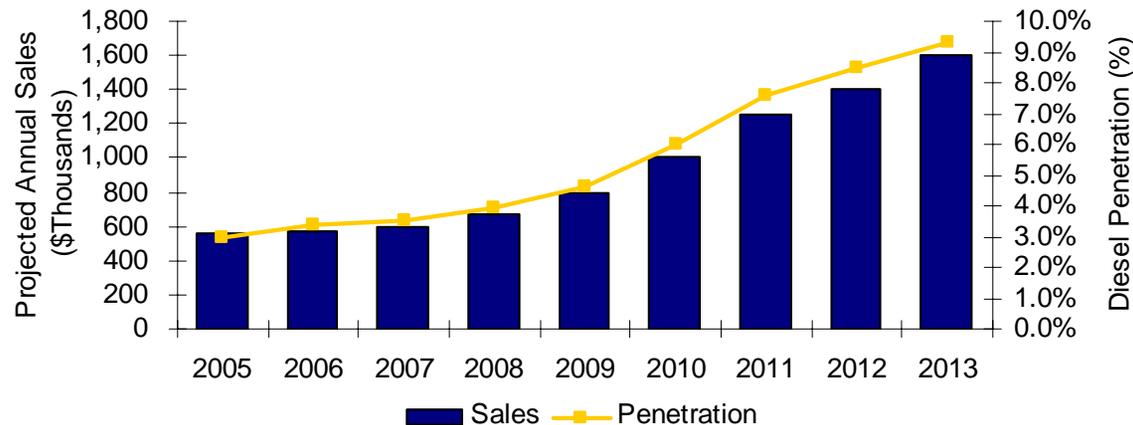
Nanostellar Overview

- Developer and manufacturer of nano-materials for diesel emissions control
 - Catalysts reduce diesel exhaust emissions
- Rational Catalyst Design technology uses fundamental knowledge of catalysts' structures and reactivity
 - Platform technology accelerates design cycle and enables complex new materials
 - New products that further improve emissions performance
 - New applications such as bio-fuels
- Nanostellar's products increase performance by 25-30%
 - First ever use of gold in automotive catalysis
- Shipments to European aftermarket customers commenced 2006
 - In Certification process for OEM use
- Operations began in 2004
 - Funded by Khosla Ventures, 3i Technology Partners, Monitor Venture Partners, etc.

Why Diesel Emissions Control

- Cleaner environment and higher fuel efficiency
 - 20%-40% greater fuel efficiency and lower greenhouse gas emissions
 - Better than gas-hybrid vehicles for suburban driving
 - 14M estimated Europe/US/Japan diesel vehicle production in 2010
 - 12M diesel cars, 2M diesel trucks
 - 55% and rising share of diesel passenger cars in Europe
 - Major auto manufacturers introducing diesel vehicles in US - Mercedes, Chrysler, General Motors, Honda, Audi, Volkswagen, BMW

Diesel Penetration and Sales in the US

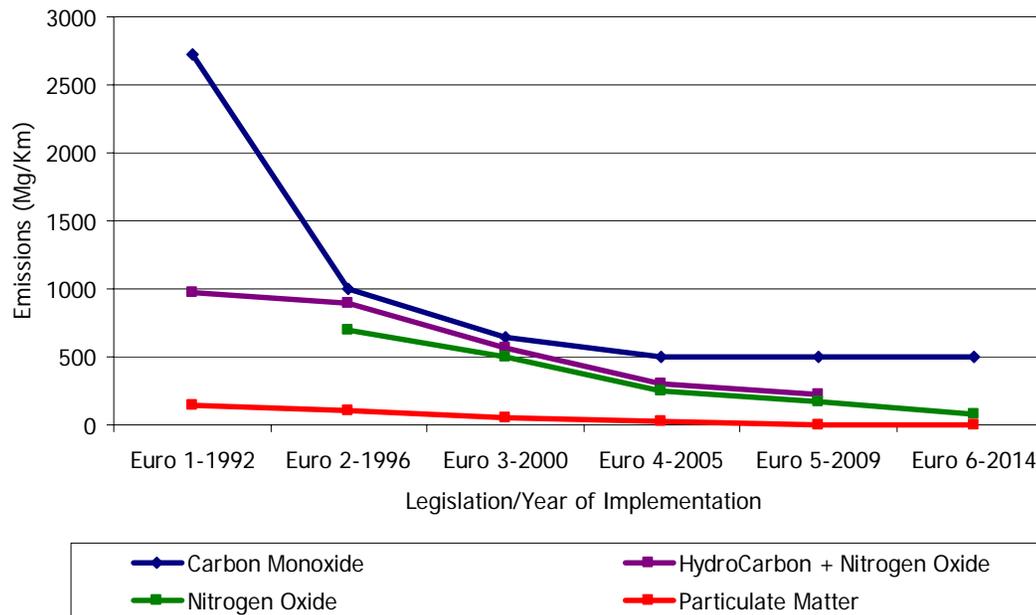


NY Times, April 18, 2007, “Modern diesel technology, already widespread in Europe, is slowly making its way to the United States. The new engines are a far cry from the coughing, stinking diesel engines of the past, and have lower greenhouse gas emissions and better fuel economy than gasoline engines. “

Emissions Regulations Driving to Almost Zero Emissions

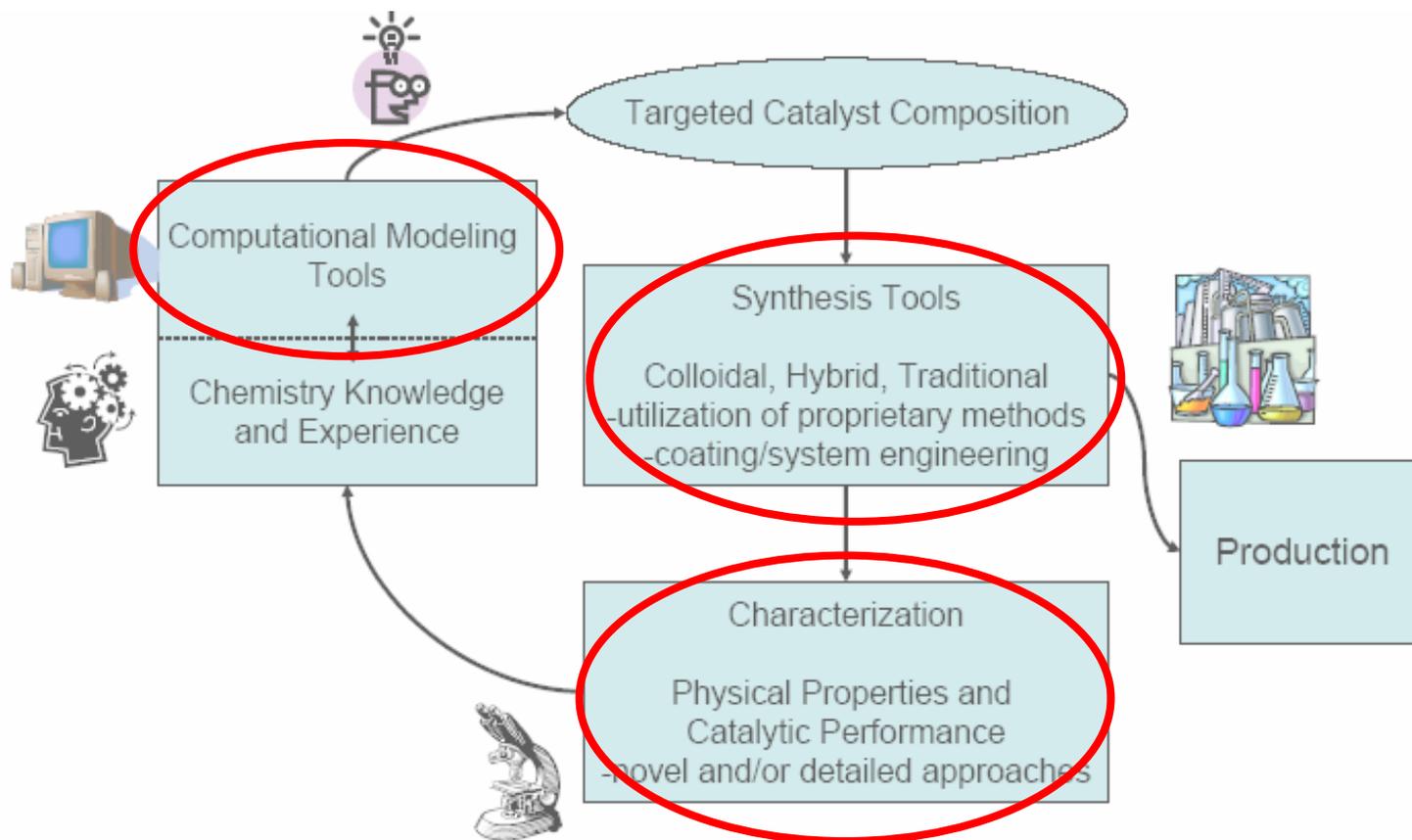
- Legislation sets diesel emissions standards as far out as 2014
 - Europe – Euro IV (2005), Euro V (2009), Euro VI (2014)
 - US – EPA'07 (2007), EPA'10 (2010), Off-road (2011)
 - China – Euro IV (major cities 2008, countrywide 2009)
 - India – Euro III (major cities 2008, countrywide 2009)

European Legal Vehicle Emissions for Diesel Engines

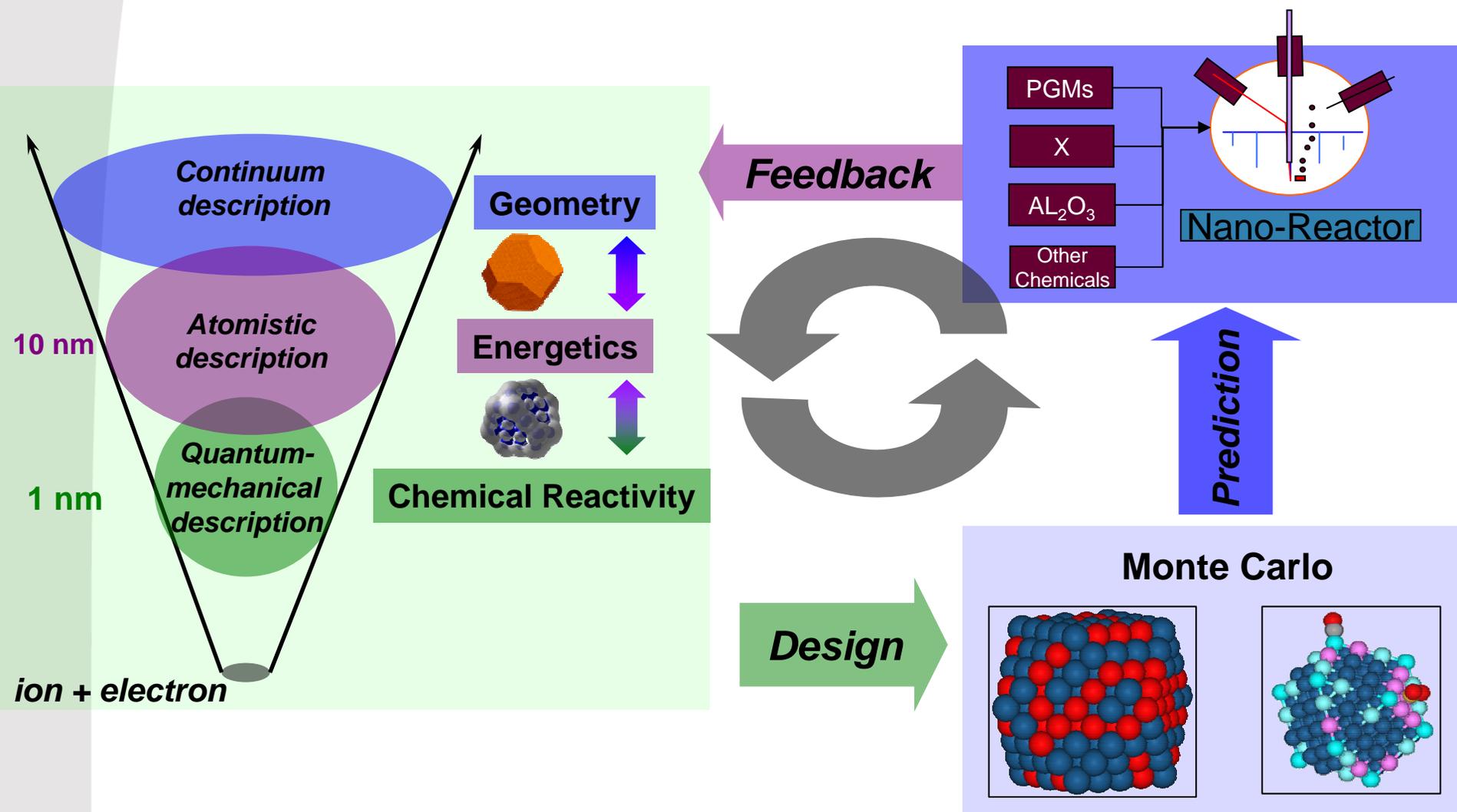


Nanostellar Rational Catalyst Design

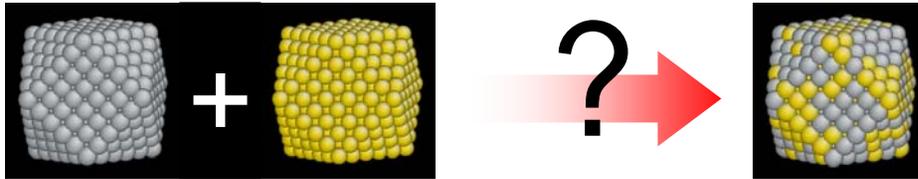
- Accelerates design cycle, reducing R&D cost and accelerating time to market for new products
- Advanced computational modeling tools allow Nanostellar to simulate thousands of chemical experiments in a matter of days



From Empirical Synthesis to Rational Design Vision

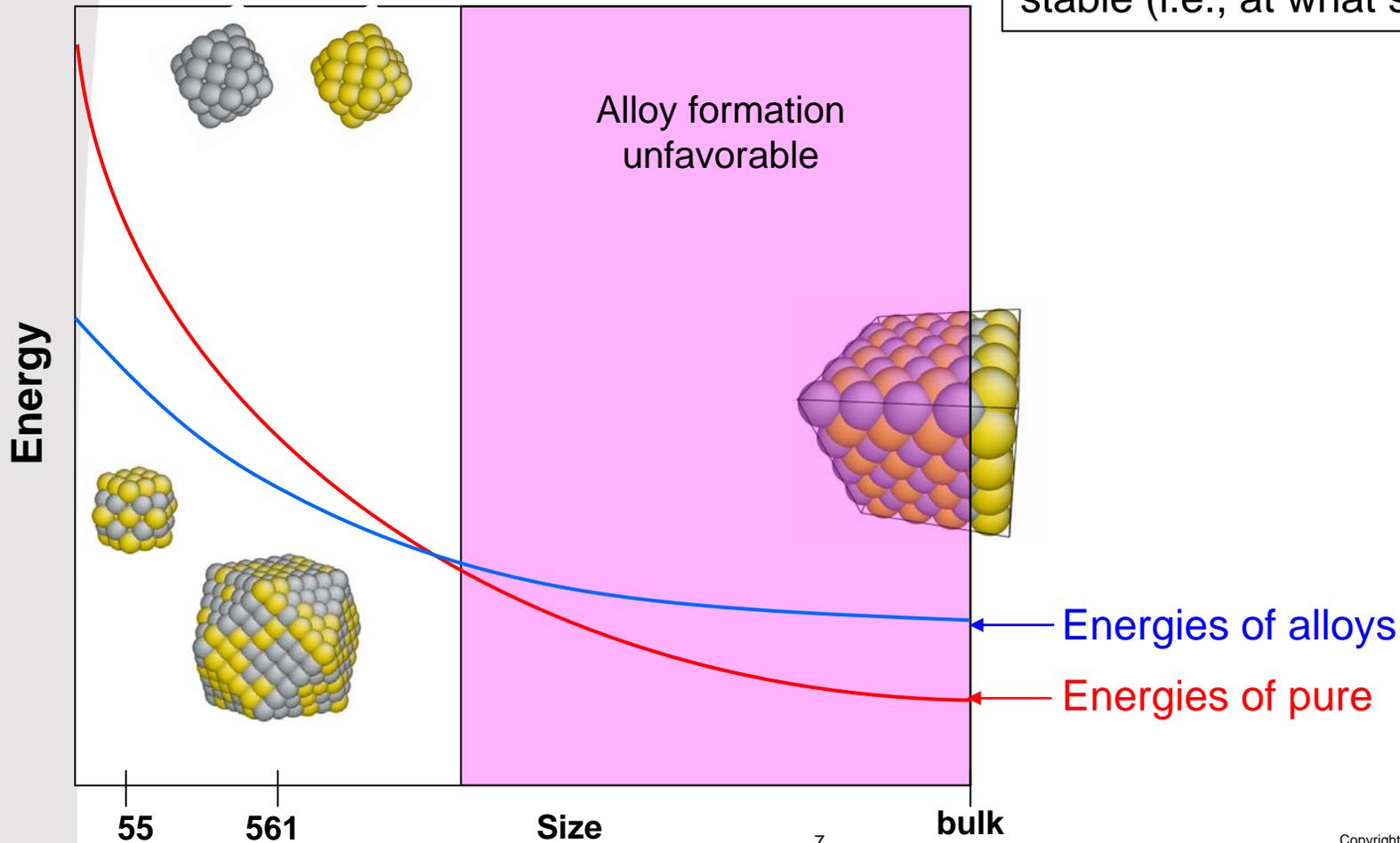


Size Effects on Alloy Formation

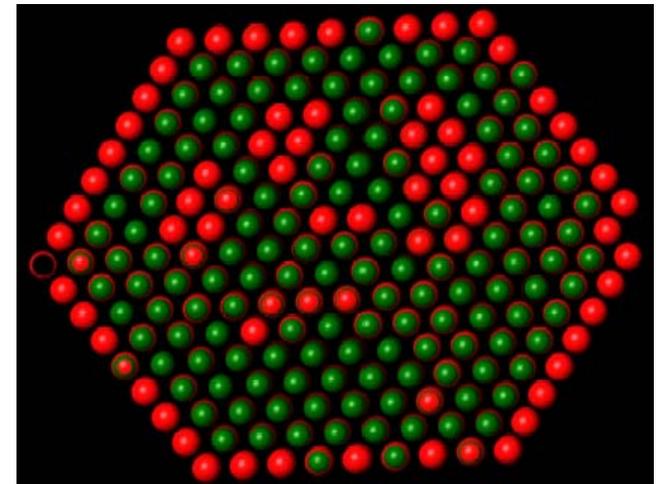
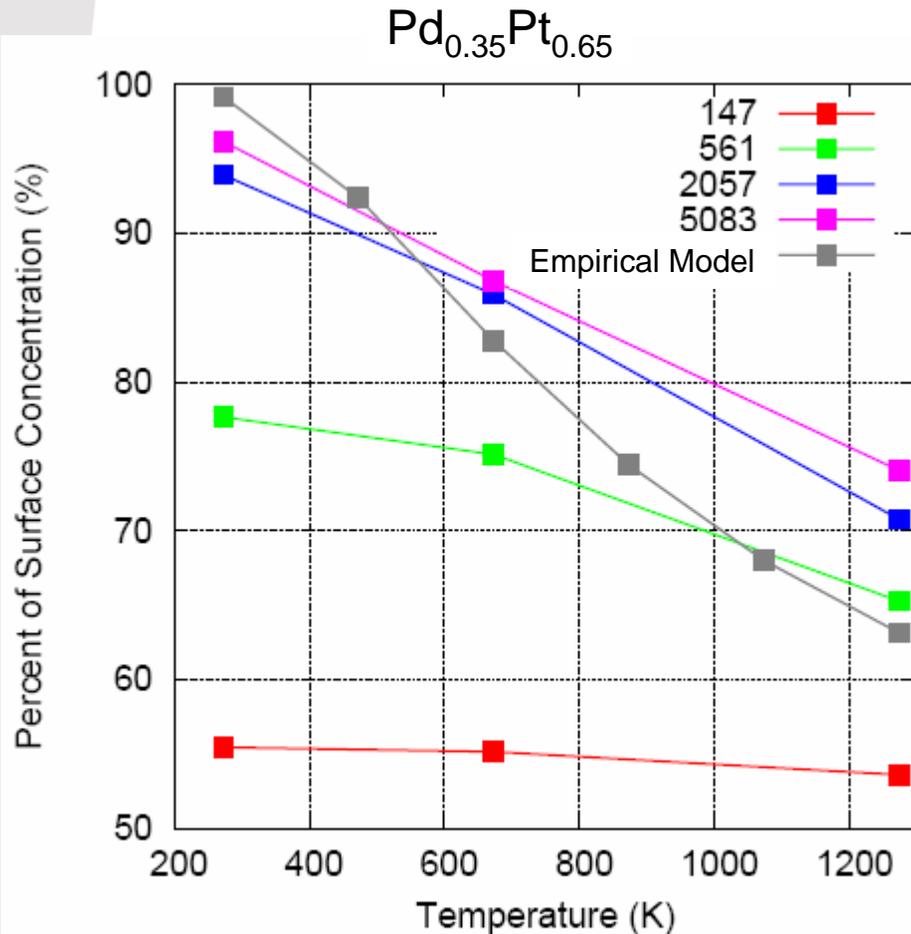


Question:

When do alloys that are not stable in bulk form become stable (i.e., at what size)?



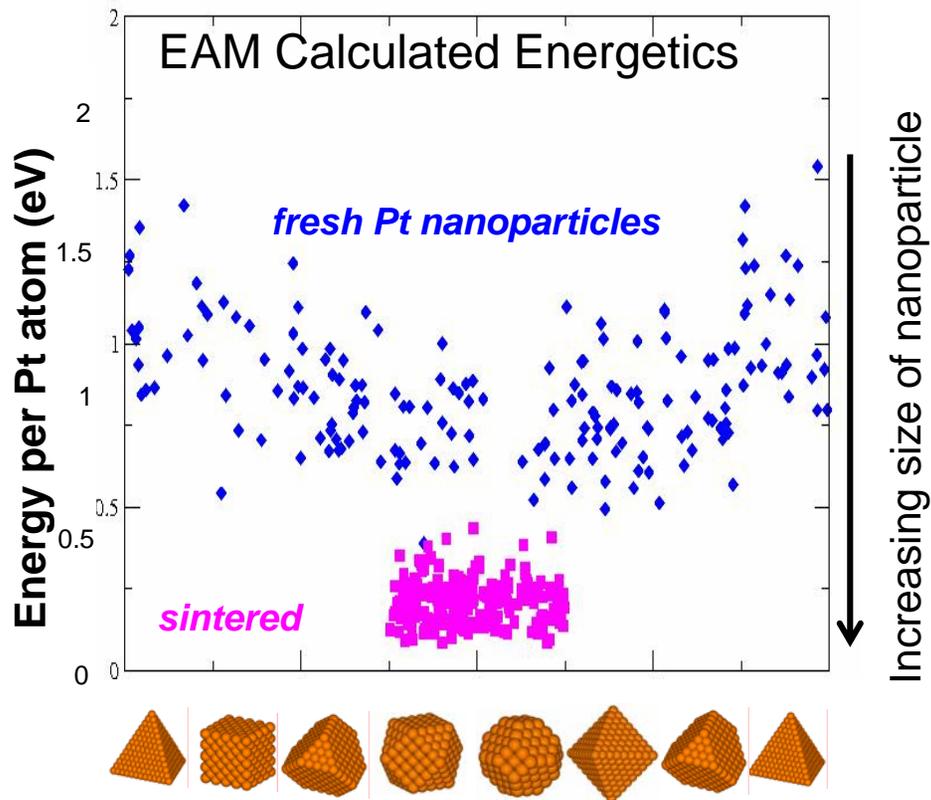
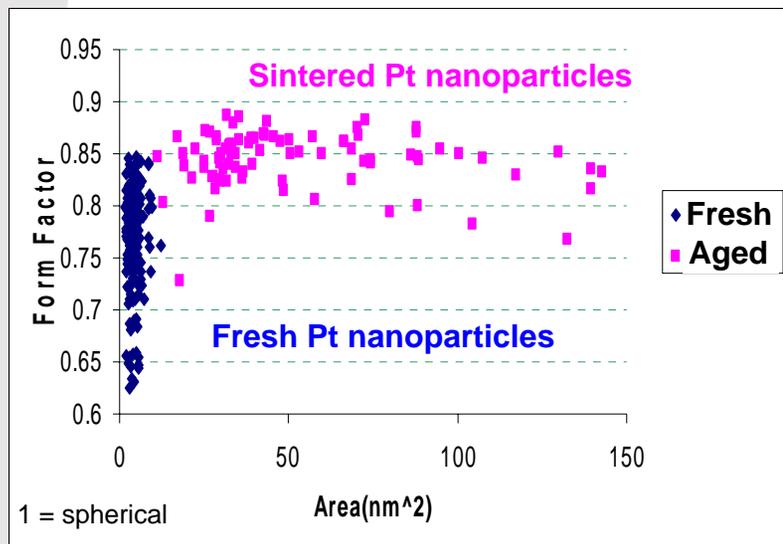
Surface Segregation Versus Temperature, Inert Atmosphere



Cross section through the simulated particle. Pd (red) is on the surface

Sintering Behavior

Experiment (800 °C, 10% H₂O)



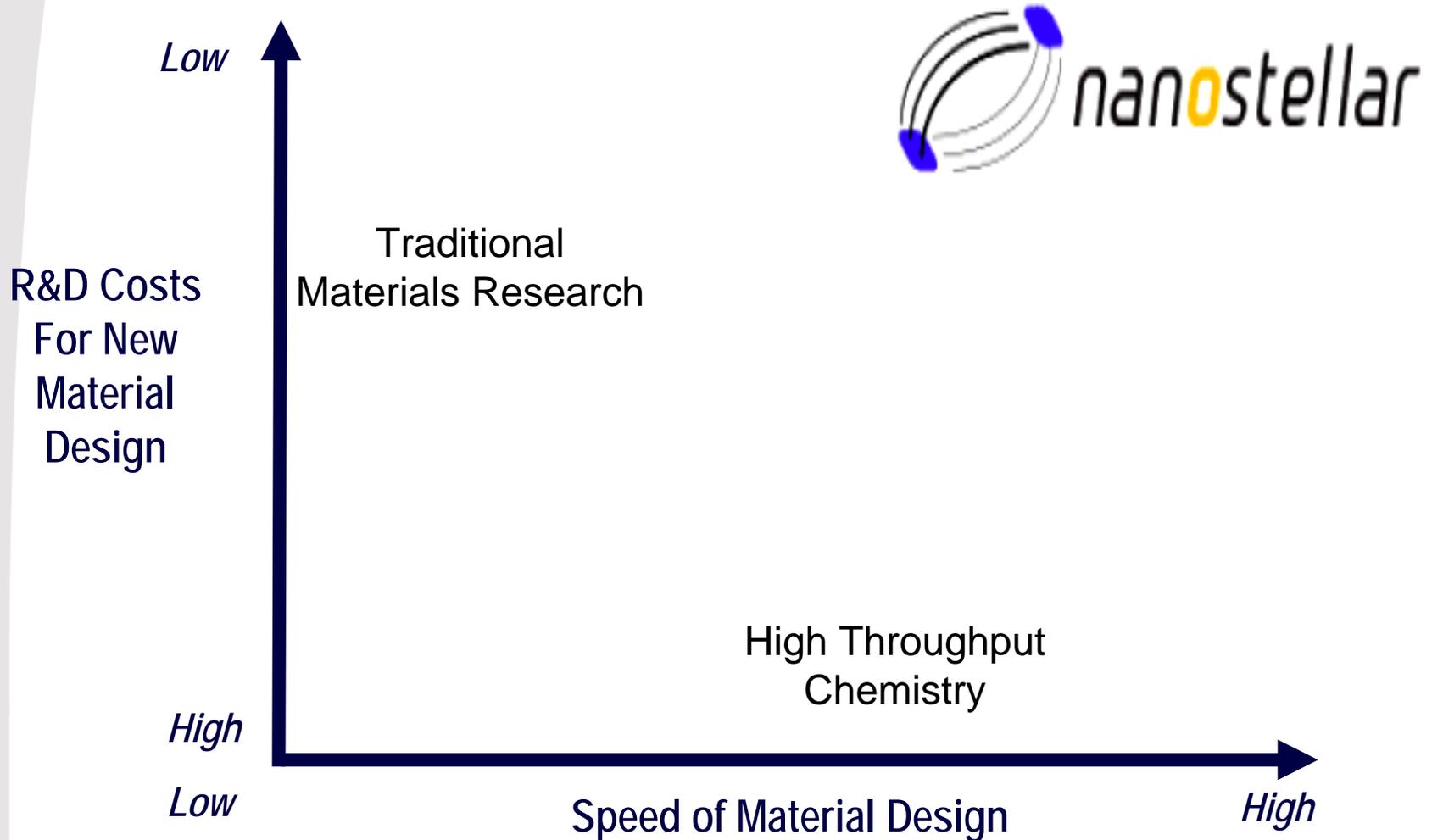
Pt nanoparticles synthesized in metastable polygonal shapes make a transition to lower energy, round shapes with added thermal energy

Suggests that initial shape control is not critical for high temperature applications (e.g., emission control)

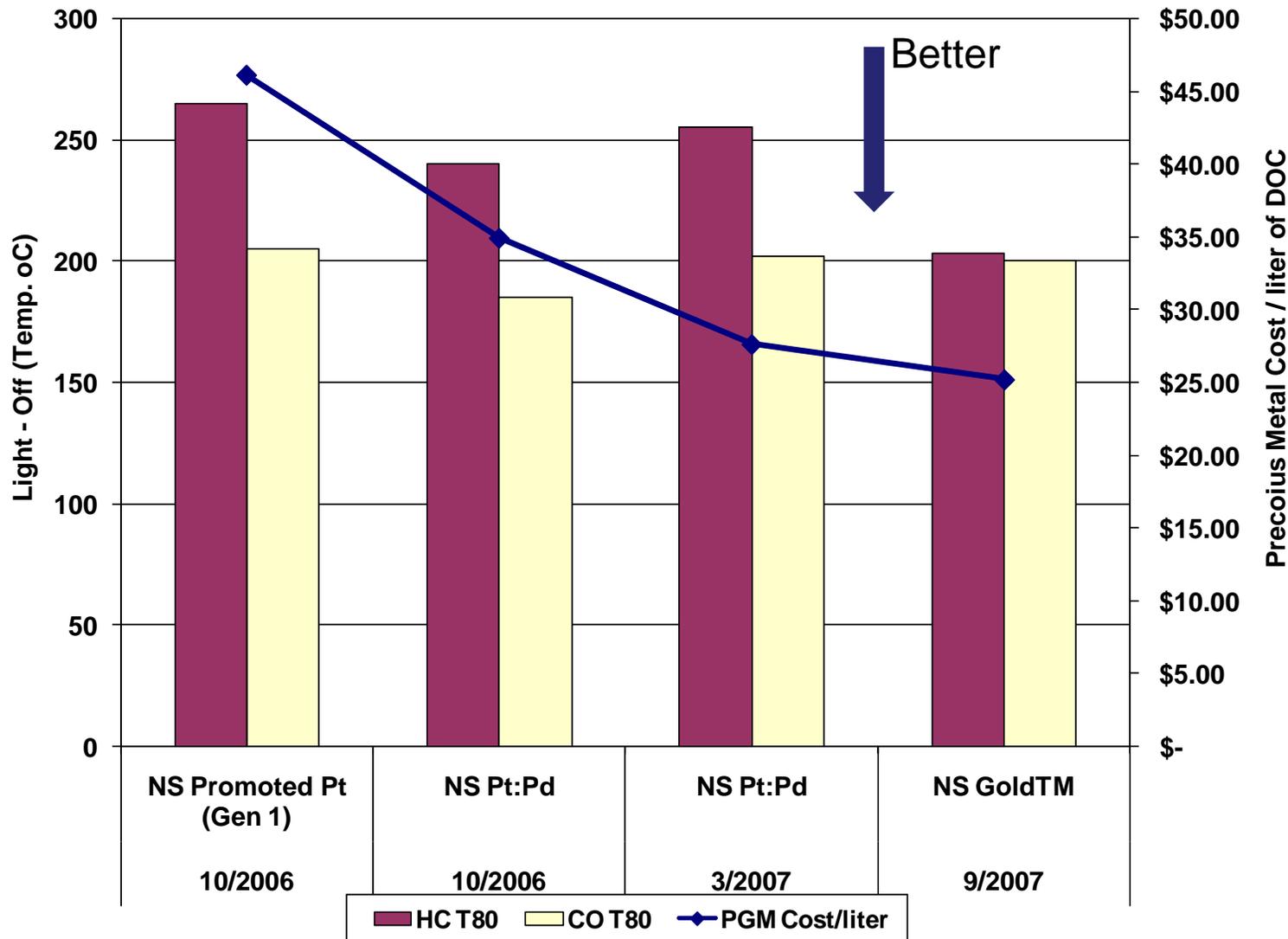
Dynamic Modeling of Aging Effects (Coalescence)



Approaches to Materials Research

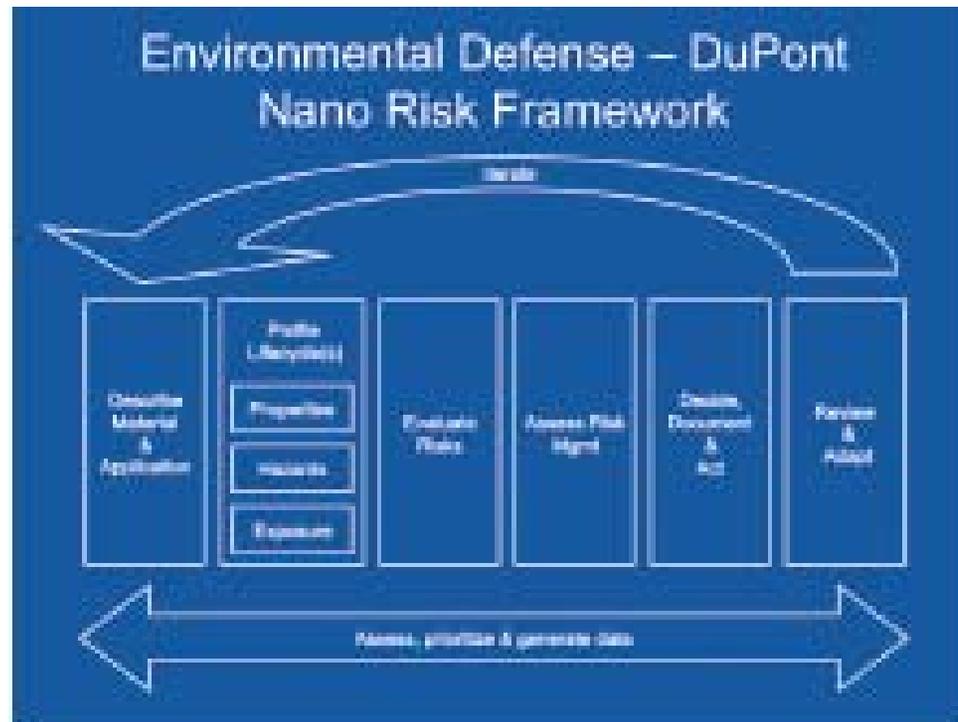


Speed Of Material Design



Life Cycle Thinking

- Participation in Dupont/Environmental Defense Nano Risk Framework
 - Structured process to make sure EH&S risks managed
- NS Materials are metal nano particles supported on large (1-80 μm) inorganic oxide supports
 - In-situ formation of particles inhibits most “nano” hazards
 - Inhalation and ingestion hazards do remain and mitigated using industry standards



Summary

- Developing unique expertise in computational modeling
 - For Application Specific Nano-Materials
 - In combination with manufacturing know how
- Competitive advantage increasing over time
 - the inter-linkages between the modeling and fabrication databases reinforce one another and grow with experience.
- Can offer immediate cost/performance benefits for Diesel Oxidation Catalyst
 - Benefits increase quickly and dramatically as modeling experience grows
- Focus is on building aggressive market presence before resourcing next application
 - Likely to be catalyst for biofuels