BASF Venture Capital's perspective on Nanotechnology

4th National Conference of the N.I.C – Nanotechnologies in the Chemical Industry

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The Chemical Company

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About BASF

BASF at a glance

BASF – The Chemical Company

- The world's leading chemical company.
- Offers intelligent system solutions and high-value products for almost all industries.

	2009	Q1-Q3 2010
Sales:	€ 50,693 m	€ 47,449 m
EBIT:	€ 3,667 m	€ 6,373 m

Segment Structure and Divisions

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Chemicals

- Inorganics
- Petro-chemicals
- Inter-mediates

Plastics

- Performance Polymers
- Poly-urethanes

Performance Products

- Dispersions & Pigments
- Care Chemicals
- Paper Chemicals
- Performance Chemicals

Functional Solutions

- Catalysts
- Construction Chemicals
- Coatings

Agricultural Solutions

- Crop Protection

Oil & Gas

- Oil & Gas

Nanotechnology is relevant to all these segments!

Nanotechnology at BASF: examples of products

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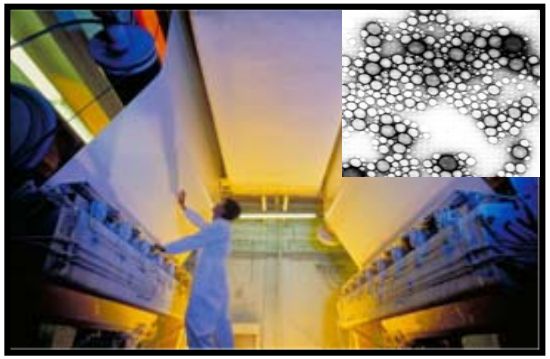
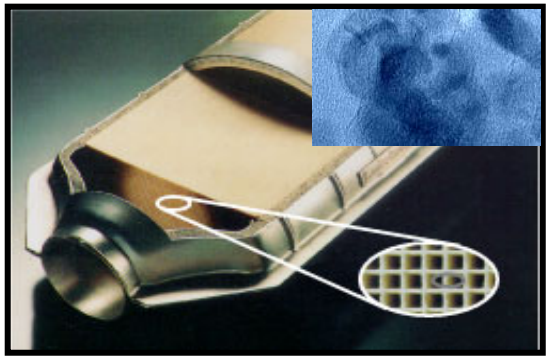
Dispersions

Pigments

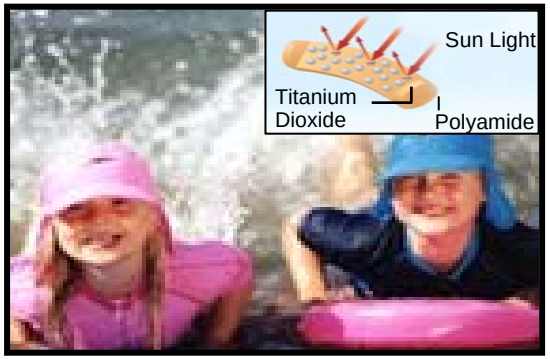
Polymers



Formulations



Catalysts



UV proctective fibers

Nanotechnology – Promises & Challenges

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Promises

Properties beyond existing materials, eg.

- High strength;
- High electric conductivity;
- Low thermal conductivity;
- Lightweight;
- Tunable light-emission frequencies (Q-dots);
- Etc.

(naturally, not all properties come simultaneously)

Challenges

- Production methods: mass scale at low cost;
- Health, Safety and Environmental challenges;
- Capital intensive deals;
- Missing the so-called “killer application”.

About BASF Venture Capital (BVC)

BASF Venture Capital (BVC)

- Founded April, 2001.
- Corporate Venture Capital branch of the BASF Group.
- 14 employees with offices in Ludwigshafen (Germany; HQ), Fremont (CA, USA), Hong Kong (China) and Tokyo (Japan).
- Vested with €150 million.
- Minority investments, ca. € 1 to 5 million per company.
- 23 direct and 5 fund investments since inception.

BVC's Key objectives

- Open a Window on Technology.
- Generate risk-adequate financial returns.

BVC Portfolio in Nanotechnology

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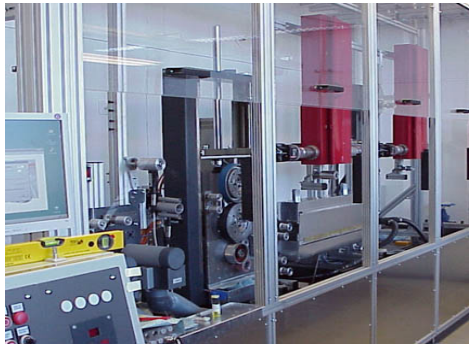
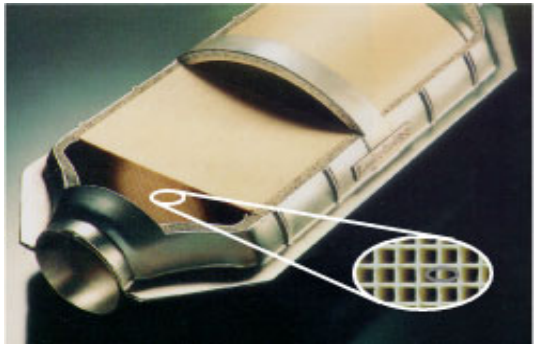
Materials

Enablers



End applications



Catalytic Solutions

SDC MATERIALS

NanoMas Technologies, Inc.

Plastic Logic

quantiam technologies inc.

OXONICA

AgION ANTIMICROBIAL
AgION TECHNOLOGIES, INC.

Nanotech is naturally a relevant topic for BASF!

Direct Investments

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June 2002 OXONICA **Nanotechnology** Oxford, UK	May 2003 Arcadia BIOSCIENCES **Plant Biotechnology** Davis, USA	May 2003 Catalytic Solutions **Catalysts** Oxnard, USA	July 2003 hte **High throughput experimentation** Heidelberg, Germany	July 2003 MED MicroEmissive Displays **Microdisplays** Edinburgh, UK	October 2003 i-components **Display Components** Seoul, S. Korea	September 2004 Sciona **Genetic Tests** Boulder, USA
December 2004 ABN Advanced BioNutrition **Functional Nutrition** Columbia, USA	August 2005 AgION ANTIMICROBIAL AgION TECHNOLOGIES, INC. **Biocides** Wakefield, USA	November 2005 Plastic Logic **Printed Electronics** Cambridge, UK	December 2005 RPC **Optical Wave Guides** Wilmington, USA	June 2006 SDC MATERIALS **Nanotechnology** Tempe, USA	September 2006 Luca technologies **White Biotechnology** Golden, USA	January 2007 UltraCell **Fuel Cells** Livermore, USA
February 2007 DataLase **Laser Marking Systems** Widnes, UK	June 2007 heliatek Organic based Photovoltaics **Organic Photovoltaic** Dresden, Germany	March 2008 base click gmbh **DNA labelling** Tutzing, Germany	May 2008 Deutsche Rohstoff AG **Precious Metals** Heidelberg, Germany	September 2008 NanoMas Technologies, Inc. **Nanotechnology** New York, USA	December 2009 quantiam technologies inc. **Specialty coatings** Edmonton, Canada	September 2010 aspen aerogels **Aerogel insulation** Northborough, USA

Quantiam - CAMOL
A Nanotechnology for Chemical Sites

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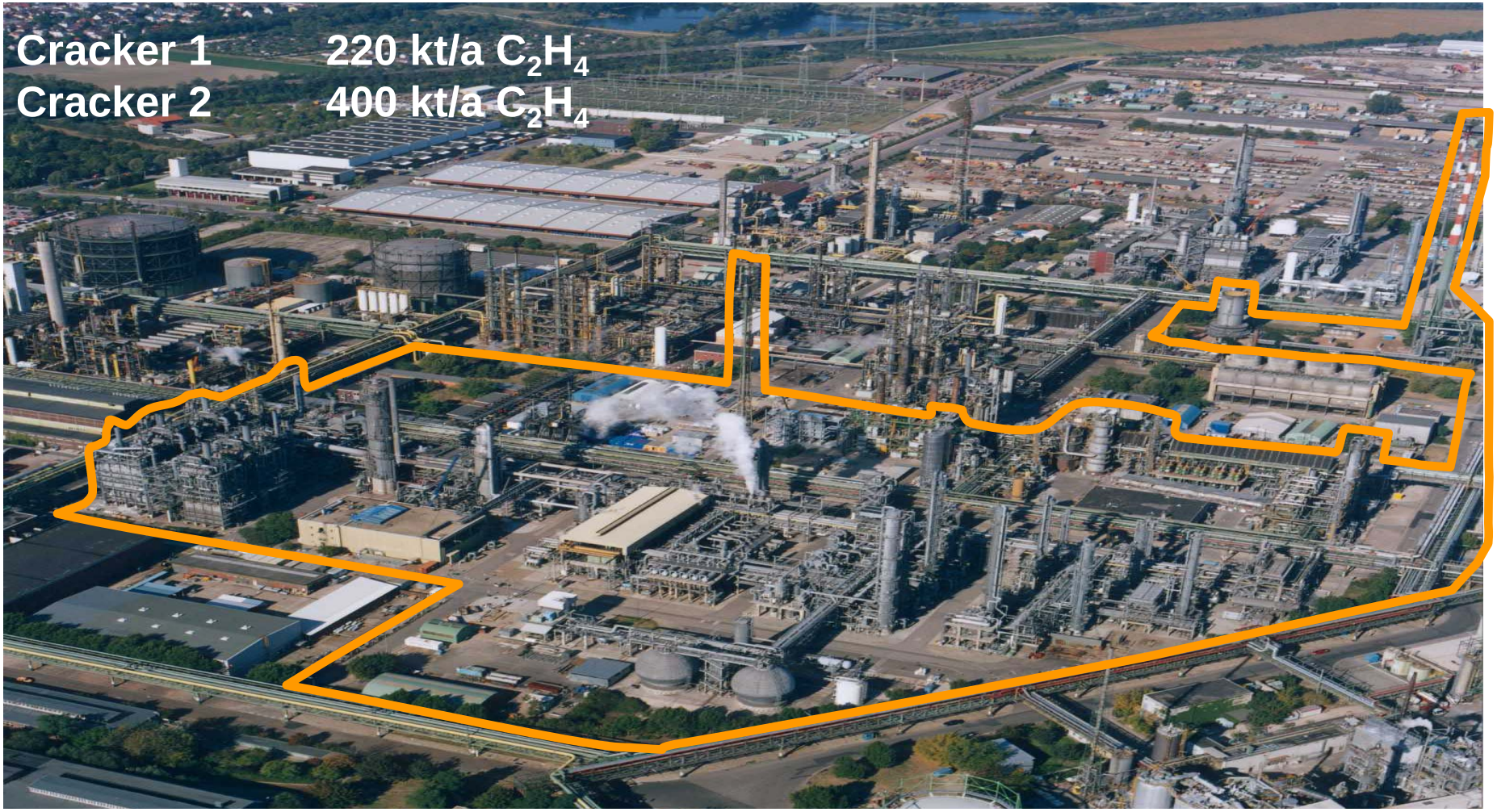

CAMOL Technology
Coke formation in steam crackers

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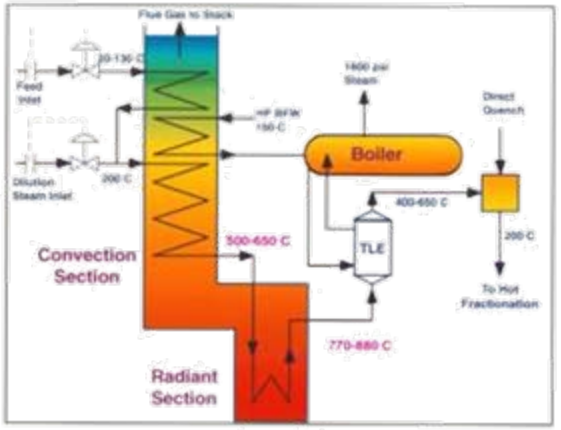
- Problem to be solved:
  - during steam cracking process coke is formed inside tubes during the thermal treatment of the feed/steam mixture inside the furnace
  - layer of coke reduces the diameter of the tube and insulates it
  - consequences of the coke formation process are:
    - higher operating temperature, energy consumption and emission of greenhouse gases
    - loss in capacity: due to decoking periods and high content of steam necessary to reduce coke formation
    - maintenance costs and reduced lifetime of tubes
- CAMOL: Catalyzed-assisted manufacture of olefins is a coating that inhibits the formation of catalytic coke and oxidizes small coke particles formed by thermally initiated processes



CAMOL Catalyst-Coating Technology Objectives

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Primary Benefits Targeted

1. Carbon (Coke)-free performance through:

- surface inertness to filamentous (catalytic) coke
- surface catalyzed gasification of amorphous (pyrolytic) coke

2. Thermal stability of overall coating, >1100ºC, >5 yrs

- with thermal stability of outermost surface, minimum of 100-150ºC > chromia

3. Resistance to broad range of materials degradation processes

- carburization
- internal oxidation
- sulfidation
- other forms of corrosion

Overall, targeted 21 chemical, physical and thermo-mechanical properties to achieve commercial viability – never before achieved, worldwide

New *nano-enabled* Catalyst Coating for Manufacturing Olefins with Lower-energy and GHG Emissions

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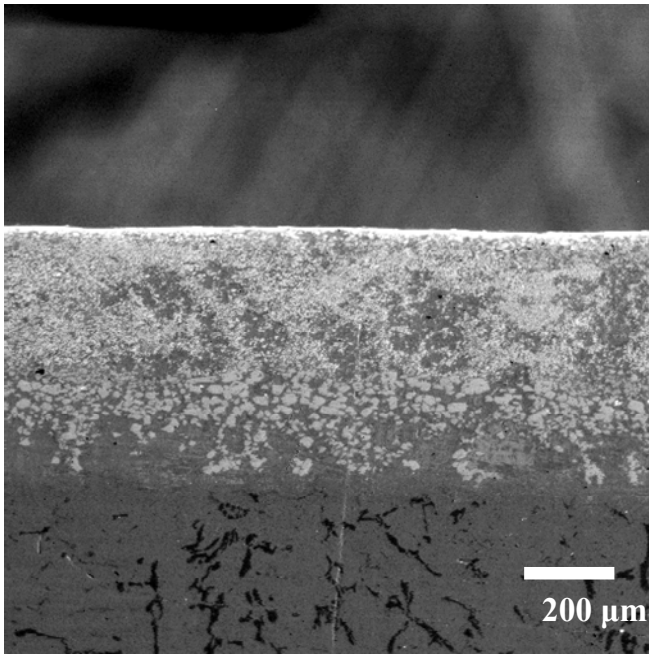
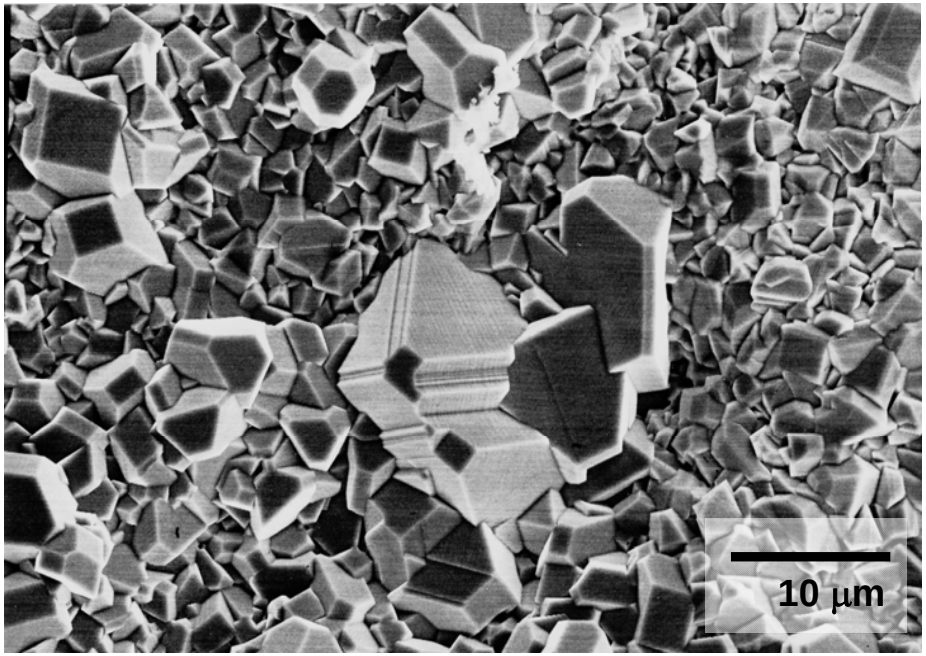


An SEM micrograph of a metallographic cross-section of the CAMOL Low-catalytic Gasification (LCG) coating ~1,000 microns thick



An SEM micrograph of the topmost surface of the CAMOL Low-catalytic Gasification (LCG) coating

Nanotechnolgy start-ups: Dynamics of IPO and M&A (1995 – 2009)

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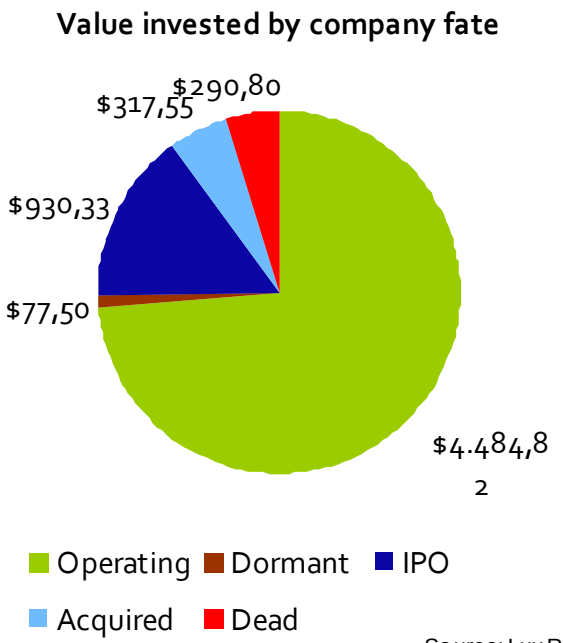
		IPO	M&A
Platform	# of exits	4,0	9,0
	average deal value	USD 22,8 m	USD 10,5 m
	average revenue multiple	28,0	7,1
	cash on cash return	3,8	2,0
Application	# of exits	15,0	15,0
	average deal value	USD 62,6 m	USD 13,0 m
	average revenue multiple	97,4	23,9
	cash on cash return	8,4	2,2

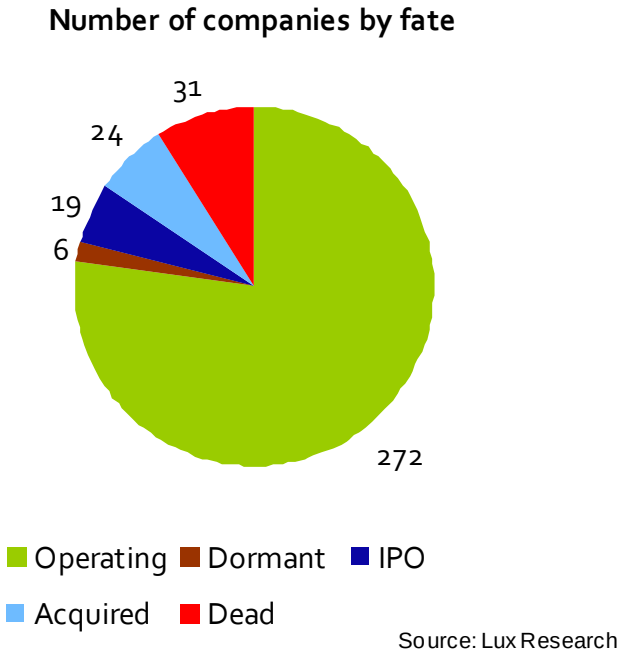
Source: Lux Research

The Nanotech Start-up World

VC-Backed nanotech Start-ups' Fates Through 2009



Source: Lux Research



Source: Lux Research

Final Remarks

- **VCs are generally more careful about Nanotech deals:**
  - Most VCs do not have the skills to understand the underlying technologies.
  - Long time-to-Exit, capital-intensive deals.
  - Only 1 “billion dollar” IPO (Battery company A123) so far.
  - Challenges around health and environmental issues.
- **The “cool-off” is not so bad:**
  - Lower valuations – better alignment with the investment risk.
  - Entrepreneurs have to articulate a clear value proposition – being NANO is not enough.