<Toray IR Seminar – No.5>

Research and Development Activities at Toray Industries, Inc.

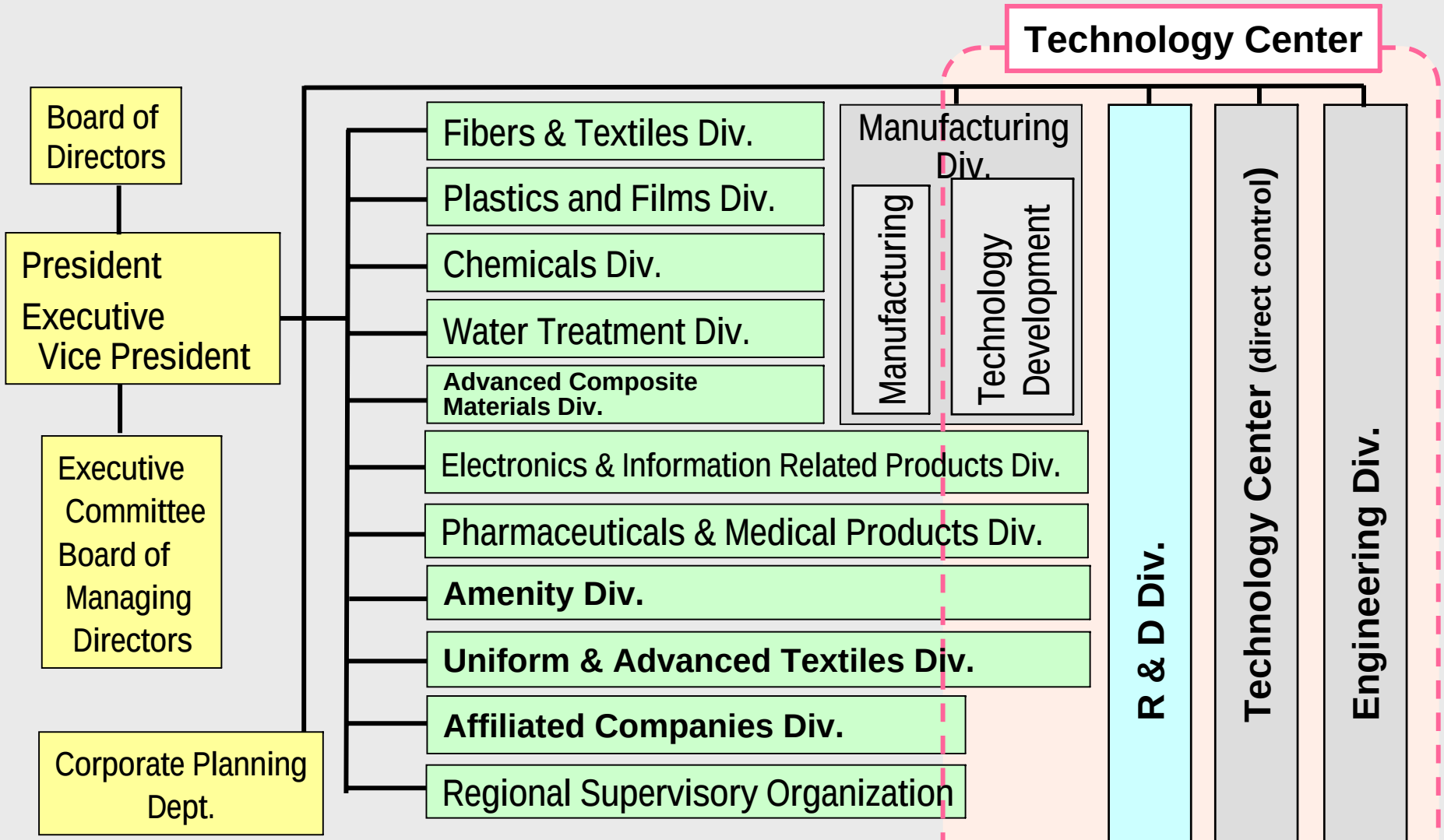
- Business Expansion by Advanced Materials -

Oct. 14, 2004

Dr.Hiroaki Kobayashi
Senior Managing Director,
General Manager of R&D Division
Toray Industries, Inc.

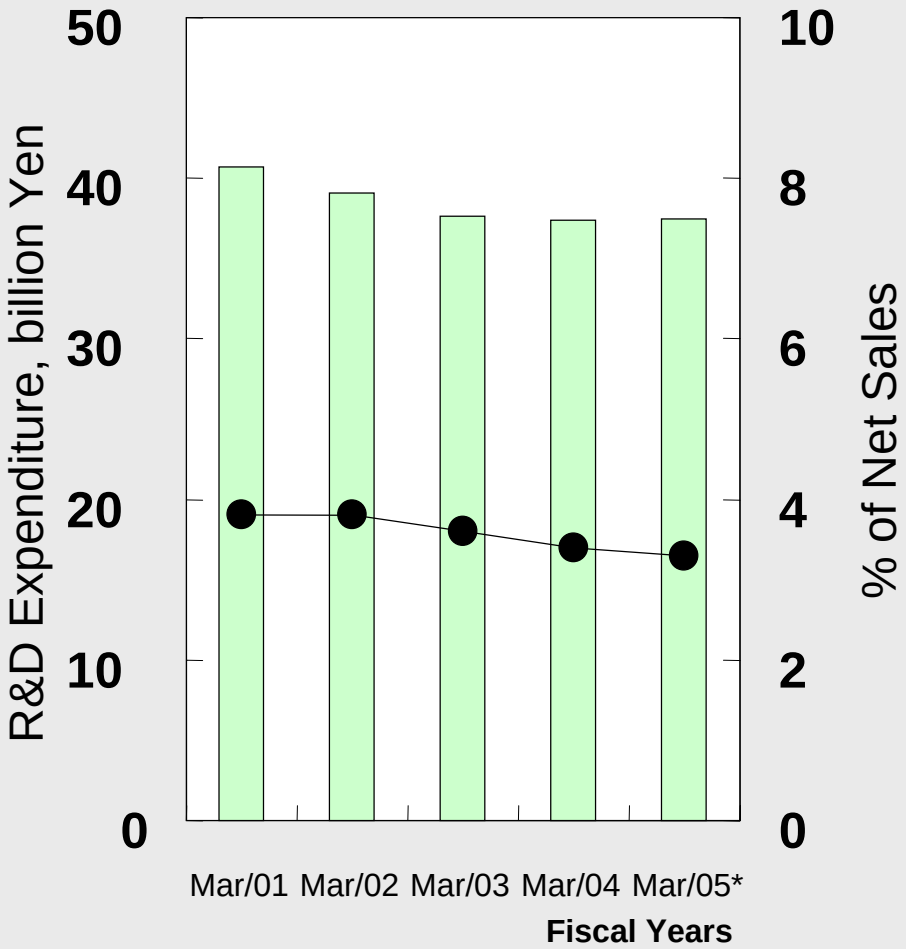
TORAY

Organization of Toray Industries, Inc.

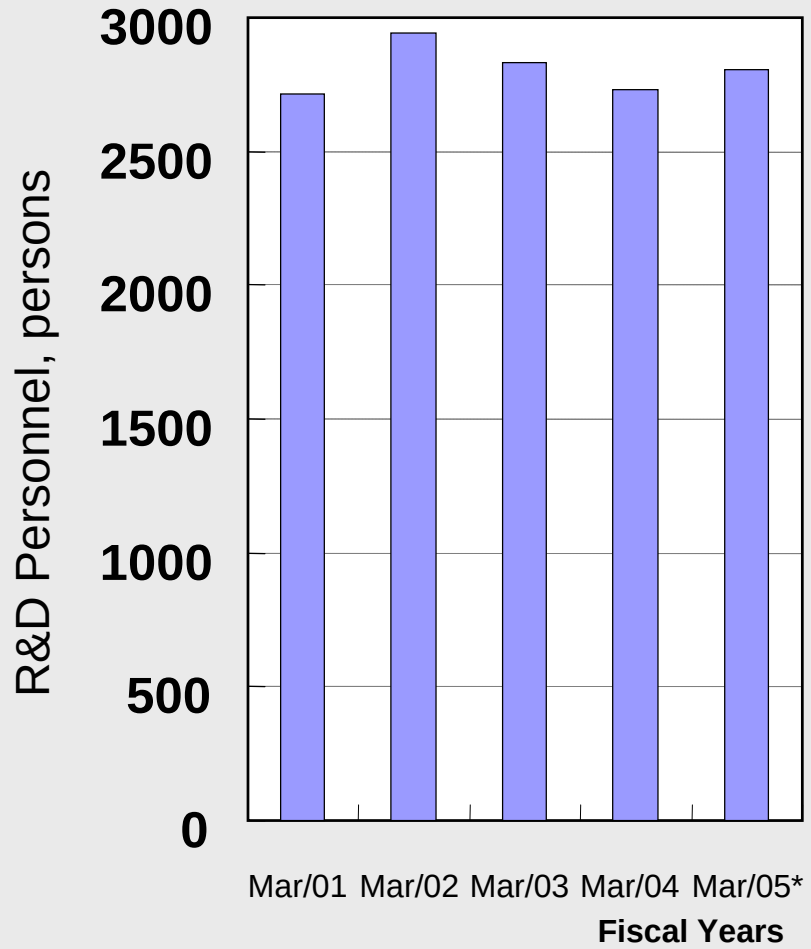


R&D Expenditure and Personnel

Approx. ¥40 billion



Approx. 2,800



(*planned)

Main Action Points of “Project NT-II”

Launched new mid-term management issues “Project NT-II” in April, 2004

Developing innovative attitudes and ideas / Reinforcing corporate structure	From the “defensive” perspective	1. Develop innovative attitudes and ideas (Revitalizing and Promoting CSR) 2. Reinforce corporate structure (Strengthening global competitiveness) 3. Reshape style of management
Expanding revenues and profits through business structure reform	From the “defensive” and “offensive” perspective	4. Reform corporate structure
	From the “offensive” perspective	5. Expand advanced materials businesses 6. Expand and reinforce global No.1 businesses 7. Expand profits from businesses outside of Japan

Urging the “offensive” management with the “defensive” perspective

↓

Early achievement of 100 billion yen in consolidated operating income

↓

Major Drive to a Global, Highly Profitable Toray Group

Strengthening of Toray R&D

Toray R&D Advantages

1. Culture and history that produce innovative technologies
   We have encouraged “challenging themes”, “underground research”, and “basic research”
2. Various kinds of specialists groups in many fields
   Ex: Polymers, IT-related products, pharmaceuticals and medical products, nano/biotechnology, etc.
3. Unified R&D structure
   Utilizes Toray’s collective strengths

Technology Integration

4. Leading company in academia – industry – government collaboration
   Over 150 joint research projects and 31 national research projects
5. Advanced analytical capabilities
   Close collaboration with Toray Research Center

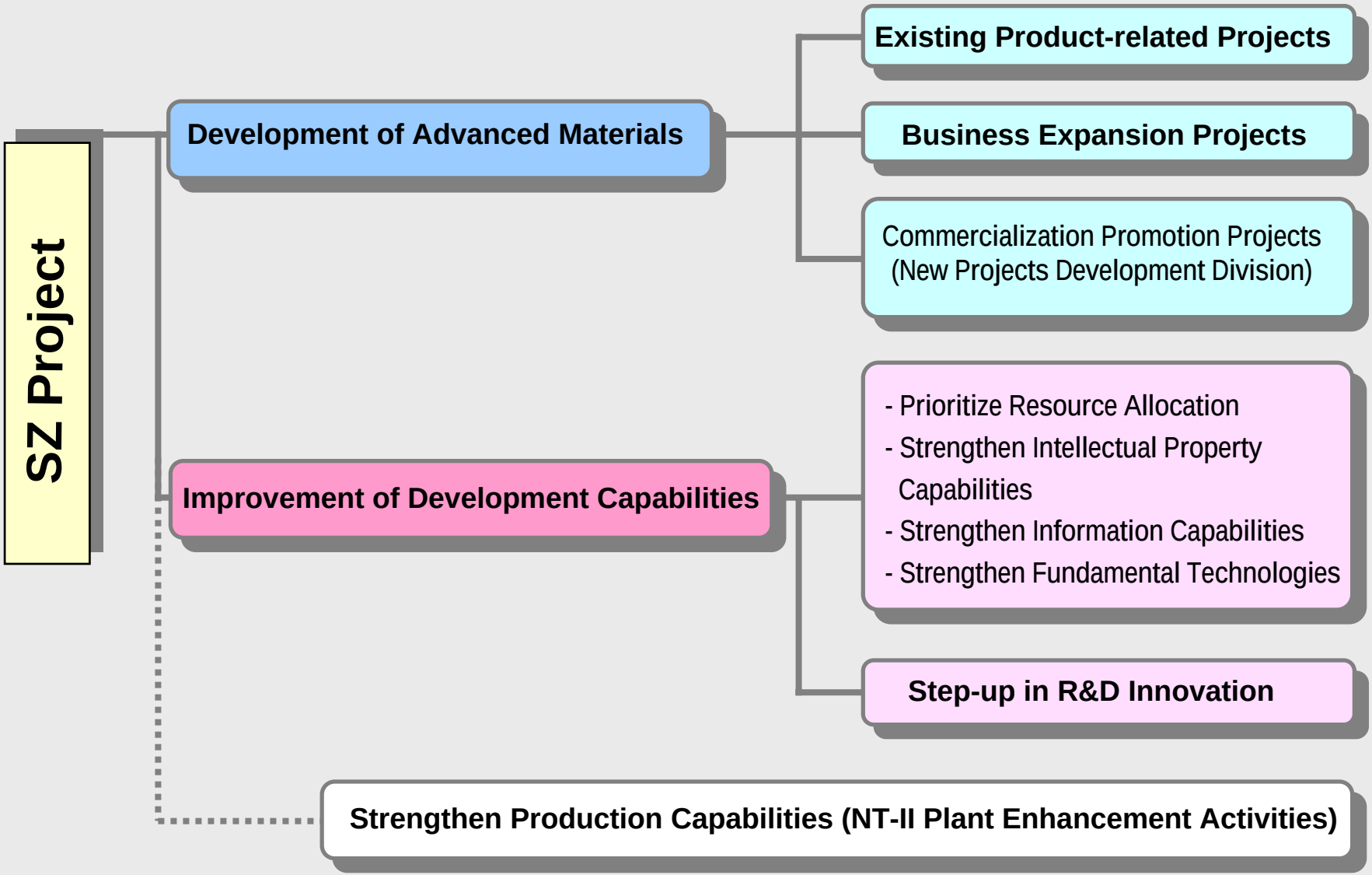
★ Attractive products only come with innovative materials

Reinforcement Points

1. Speed-Up
2. Improve “efficiency”, “effectiveness”
3. Strengthen basic / fundamental technologies

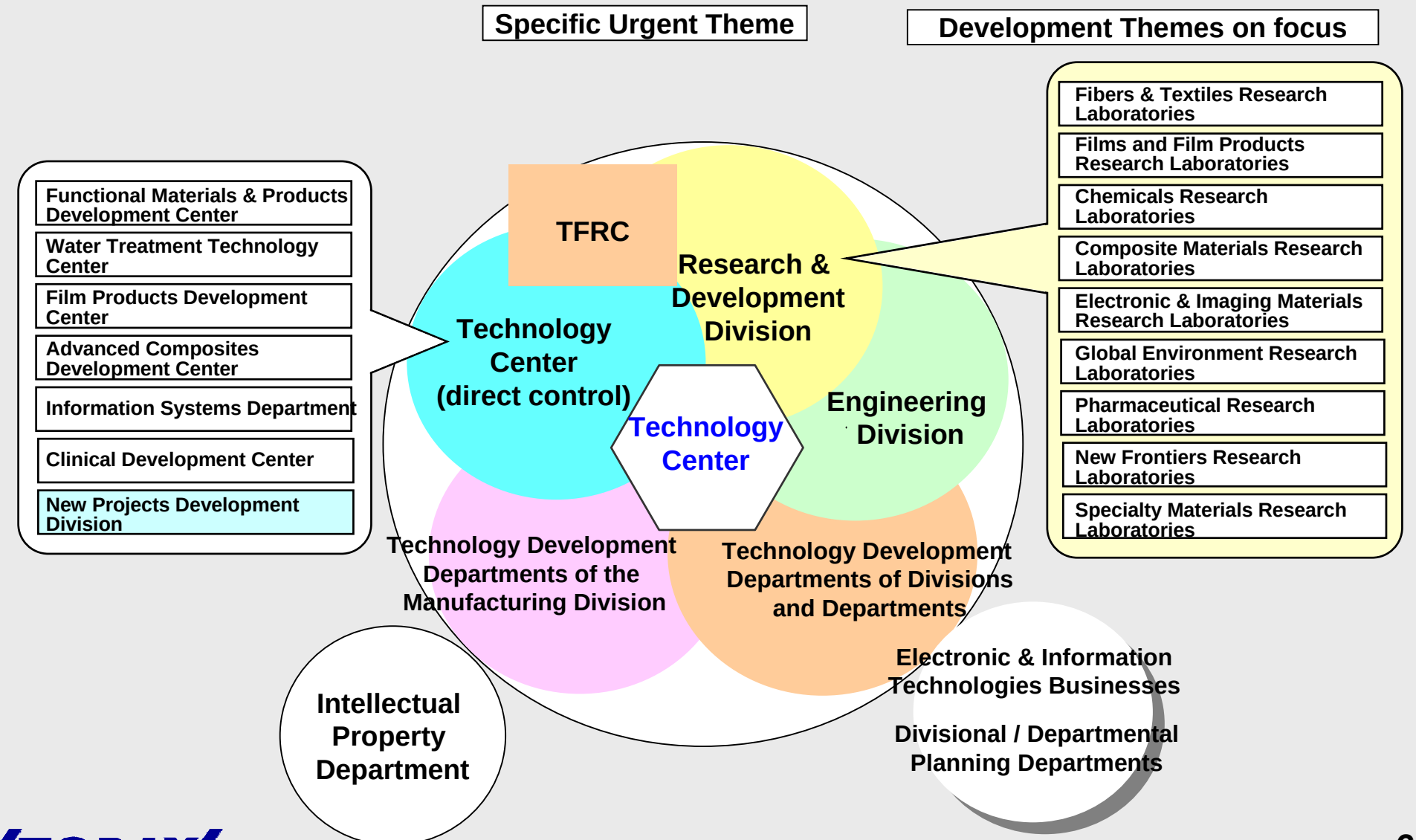
→ Achieve in “Expansion of Advanced Materials Businesses” project
→ Promotion of “SZ project”

Promotion of "SZ Project"



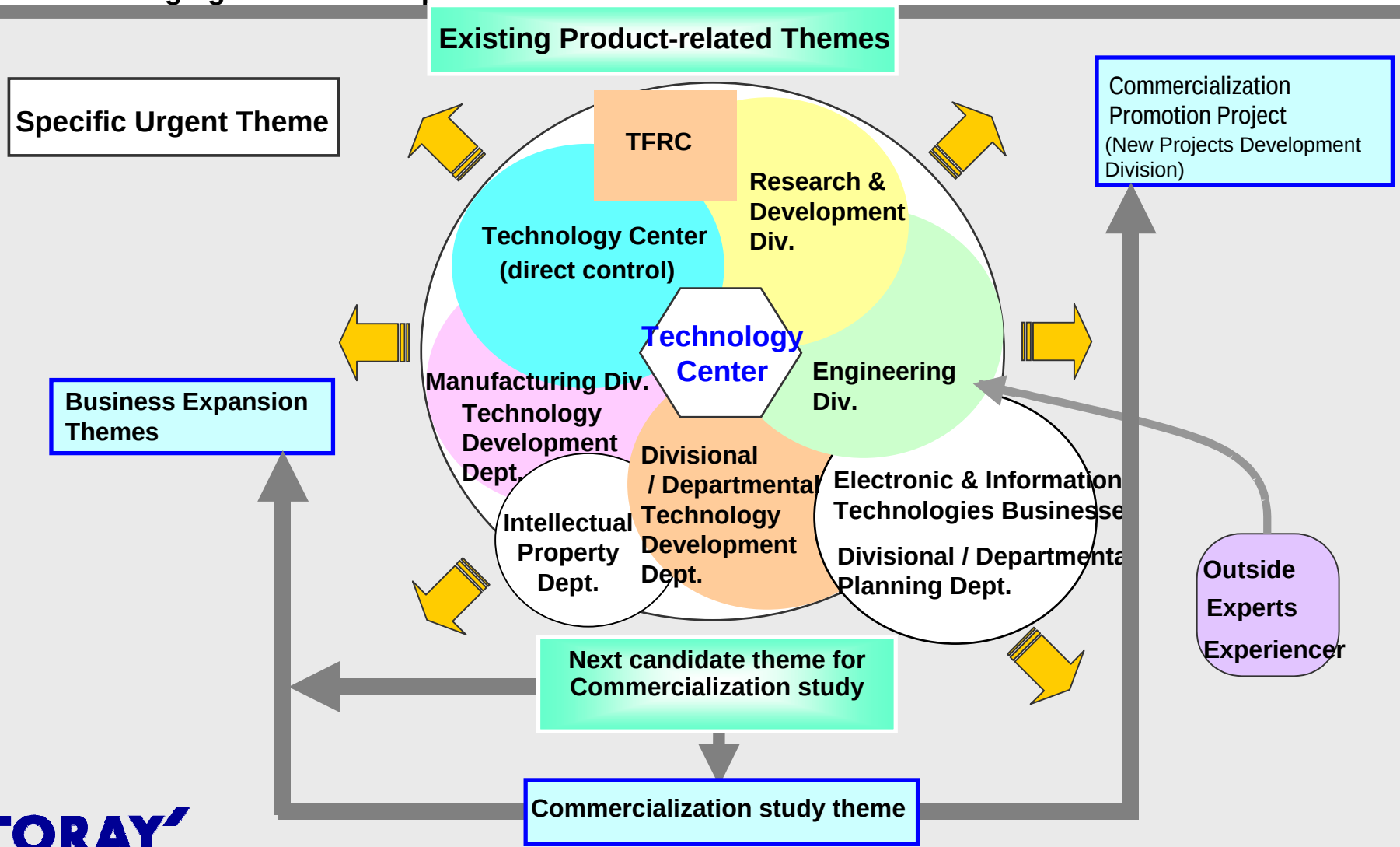
R&D / Technology Development Structure of the Technology Center

[Priority Issue at Technology Center]



Dynamic Management of R&D / Technology Development

- Create a scenario under central control by interlinking technology, production, and marketing from the early R&D stage
- Strategic management such as concentrating on the theme as a project for 1 to 2 years and returning it to the belonging division or department.



Creation of Advanced Materials

1. Development of Advanced Nanomaterials

- *Nanofibers*
- *Multi-nanolayer films*
- *Nanoalloy Polymers*
- *Carbon Nanotubes*

2. Development of IT-related Materials

- *Circuit / Mounting Materials*
- *Semiconductor-related Materials*
- *FDP-related Materials*
- *New Areas*

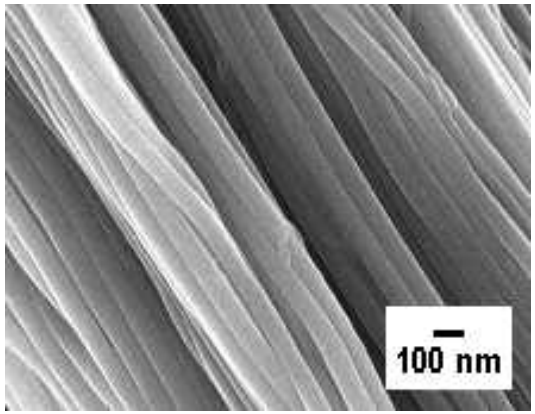
3. Efforts in Environmental Areas

- *Recycling-oriented Materials*
- *Environmentally Friendly Materials*
- *Global Warming Prevention Materials*
  (Carbon Fibers Composite Materials)
- *Resolution of Water Pollution Problem*
  (Separation Membranes for Water Treatment)

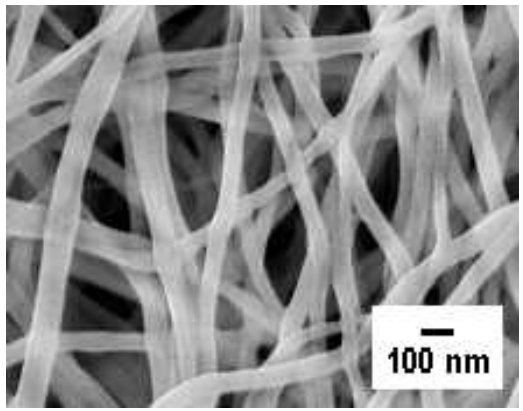
Nanofibers

Various Forms of Nanofibers (Nylon, PBT)

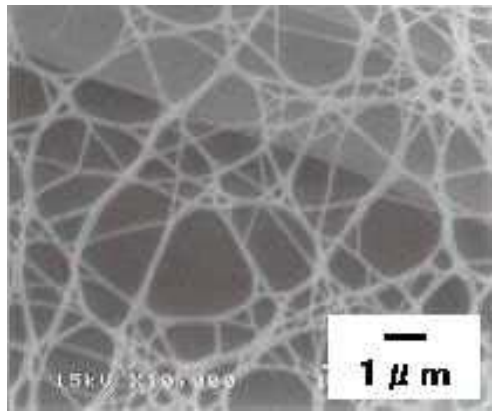
Bundles



Fiber Dispersion



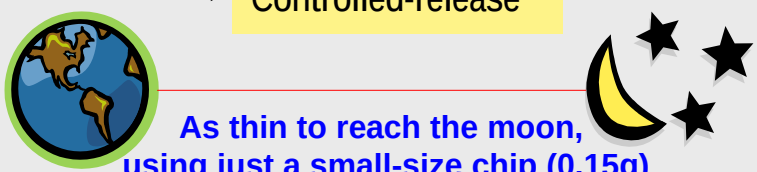
Spider Web



Expected Nano-effects → **Expanding Applications**

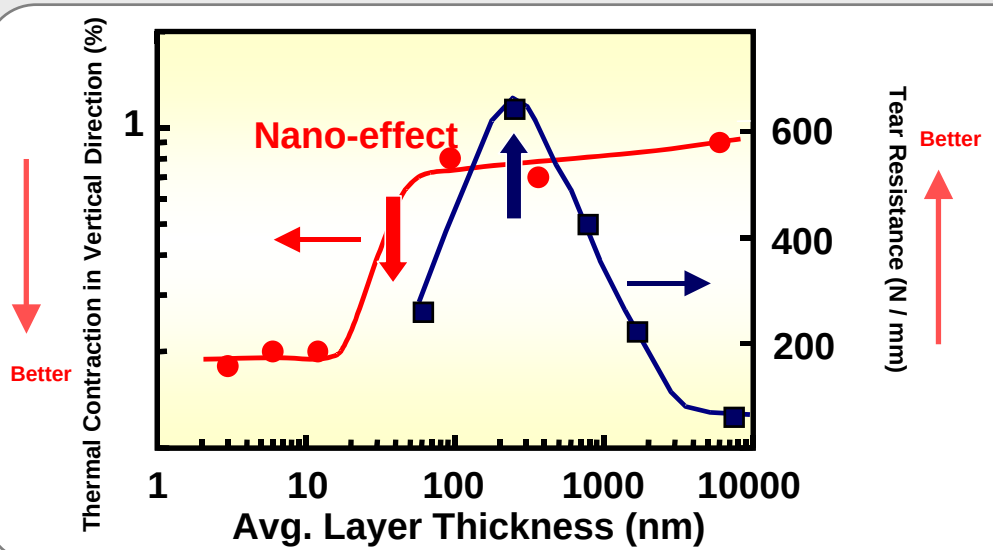
- **Extreme Thinness**
  - **Pliability**
  - **Nanopores**
  - Nanoirregularities
- **Higher Surface Area**
  - Adsorption/Absorption
  - Controlled-release

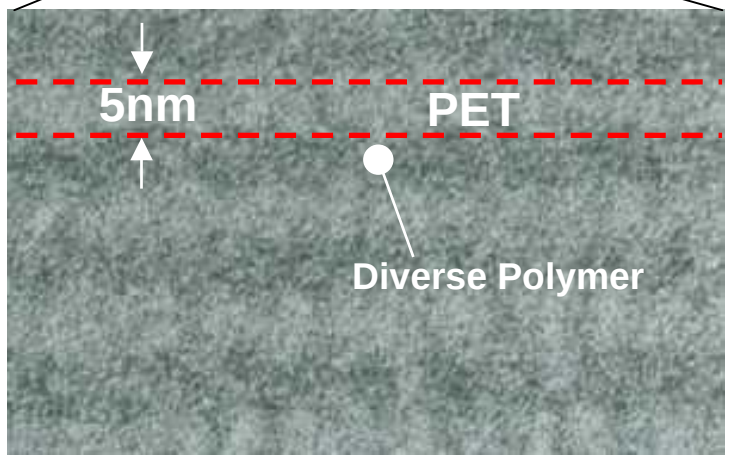
High-performance Air Filters
High-performance Fluid Filters
Wiping Cloth
Apparel of Quality
Medical Substrates



As thin to reach the moon, using just a small-size chip (0.15g)

Multi-nanolayer Films

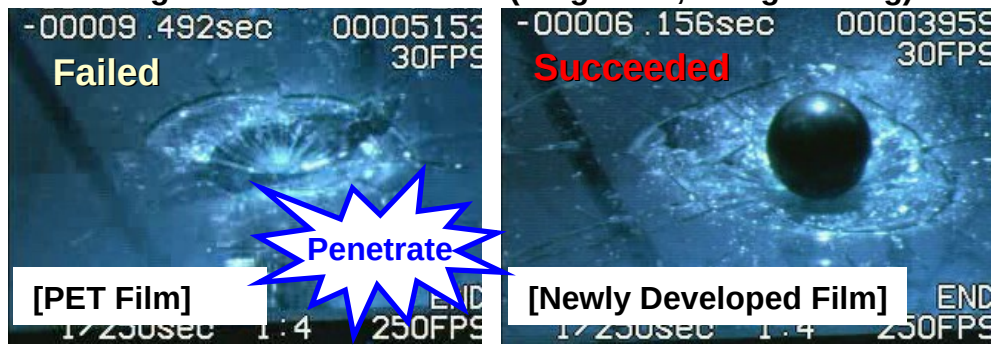




Expanding Applications

- ◆ Glass Protective Films (for safety & security)
- ◆ Electronic Materials
- ◆ Optical Functional Tapes

Falling Ball Penetration Test (Height:3m, Weight:2.2kg)



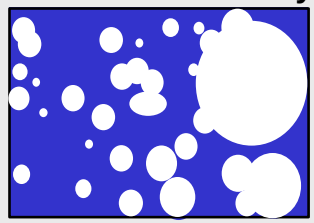
Nanoalloy Polymers

Success in structure control of Nanoalloy Polymers

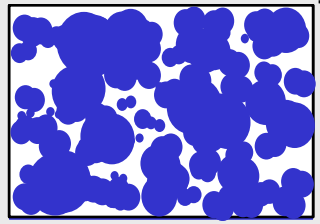
Polymer A + Polymer B

Polymer Design
Compatibilizer Design
Compound Technology

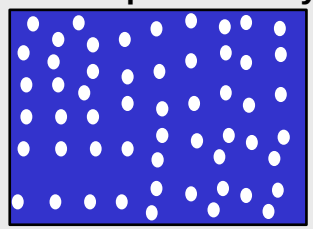
Conventional Alloy



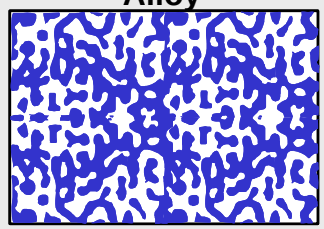
Phase-inversed Alloy



Nano-dispersed Alloy



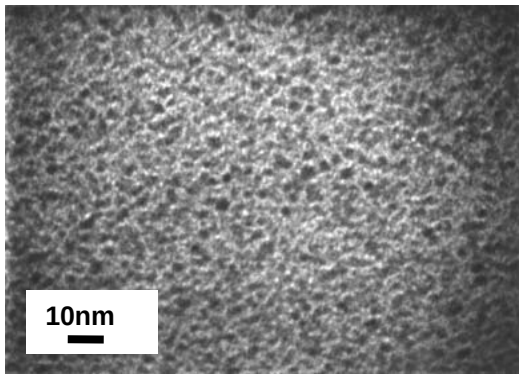
Nano-co-continuous Alloy



Improved Properties

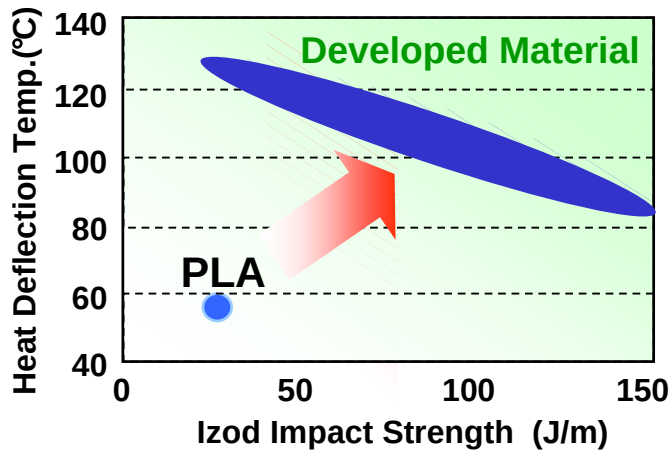
- Heat Resistance
- Impact Strength
- Chemical Resistance
- Flowability
- Moldability

(e.g.) PLA Nanoalloy



Electron microscope photo

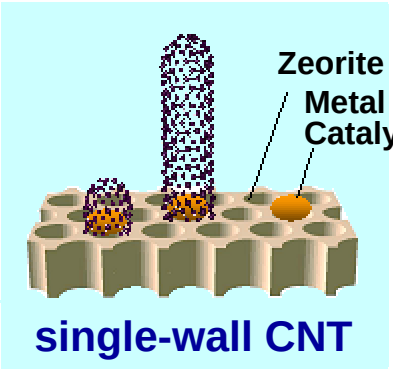
High-performance diverse polymer formulates a network structure which improves moldability and heat resistance



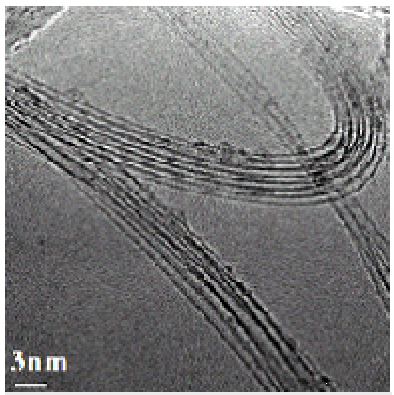
Properties of Developed Material

Carbon Nanotubes (CNT)

CCVD (Catalyst-supported Chemical Vapor Deposition) Method Using Zeolites

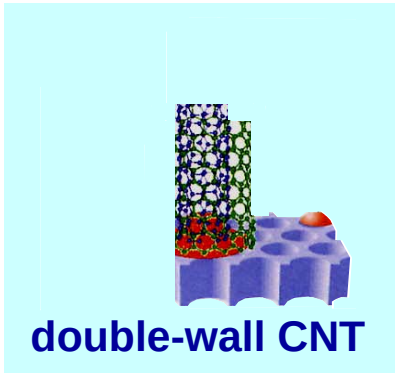


single-wall CNT

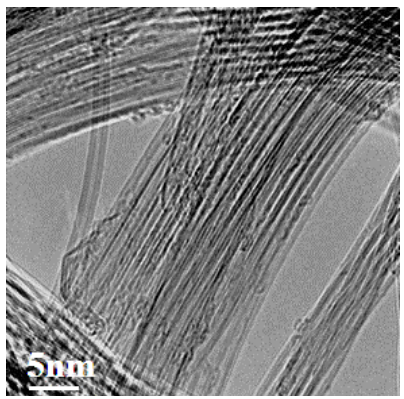


CNT purity : 99% or more
Single-layer CNT purity :
90% or more

Collaboration : Prof. Maruyama
Univ. of Tokyo



double-wall CNT



CNT purity : 99% or more
Two-layer CNT purity :
60% or more

Collaboration : Prof. Shinohara
Nagoya Univ.

Study Progress

- Completion of large test production facility
- Launch of mass production technical study
- Promotion of study on secondary processing technology
- Promotion of application research with outside partners

Expanding Applications

- Display Materials (electron emission materials)
- Fuel Cell Materials (catalyst carriers)
- Polymer Additives (electro-conductive, exothermic materials)

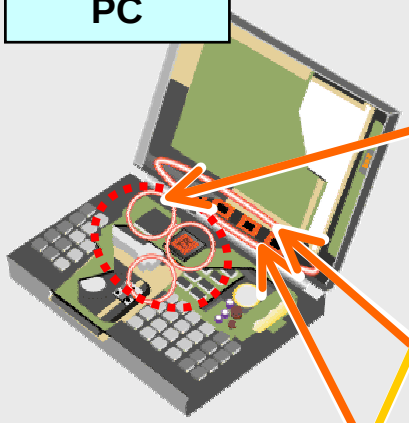
Development of IT-related Materials

- Development of Electronic Circuit, Package and Module Materials
- Development of Semiconductor-related Materials
- Development of Displays Materials
- Developing New Areas

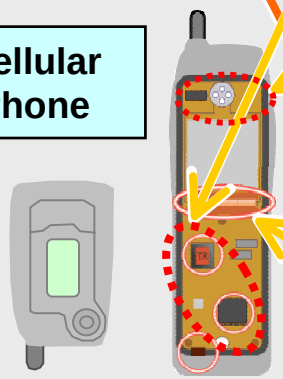
Development Circuit and IC Assemble Materials

Polymer Design / Films / Coatings / Adhesives / Plating / Particle Dispersion

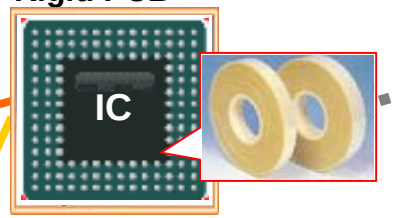
PC



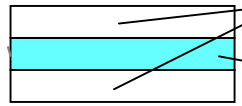
Cellular Phone



Adhesives for Rigid PCB



Adhesive Sheets for Chips

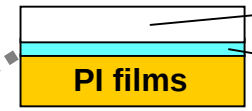


PET Covering Film

Adhesive + Particles

Flexible PCBs for IC Mounting

Adhesive Films for TAB



PET Covering Film

Adhesive

PI films

Copper Foil Laminated Films

Copper Foil

Adhesive

PI films

Flexible Printed Circuit

Copper Plated Films

Copper Plated Films

PI films

PI : polyimide

Inorganic Particles
High-density
Nano-dispersion

High Dielectric Constant Materials

Functional Polymer Design
Inorganic Particles
Dispersion

Hybrid Materials

High Adhesive Strength / High Dimensional Stability

Next Gen. Patterning Tech.

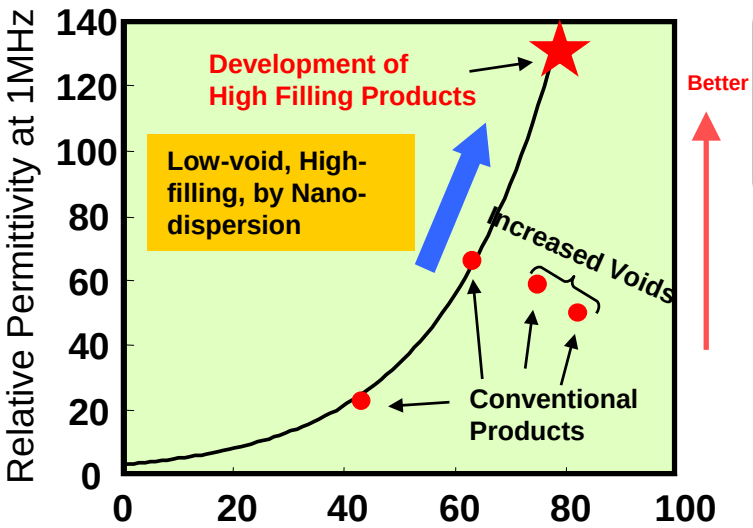
Electronic Devices

Down Sizing: Smaller / Thinner → **Higher Functional Integration**

TORAY

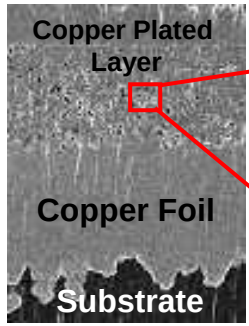
High Dielectric Constant / Hybrid Materials

High Dielectric Constant Interlayer Insulating Material for Substrate-embedded Capacitor

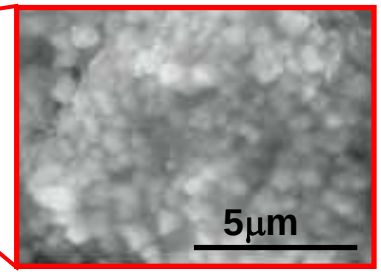


Relative Permittivity “125” : The world highest level as organic-inorganic composite materials

Filling Factor “80%” : Realized by Toray’s Nano-dispersion technology

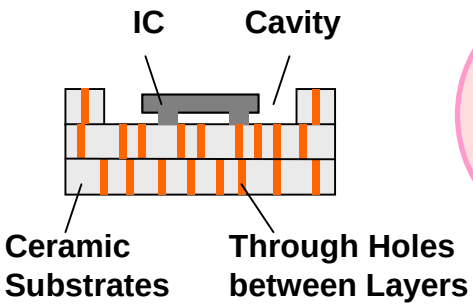


High Dielectric Constant Layer



Hybrid Material for Multilayer Ceramic Substrates

Example of a High-frequency Module



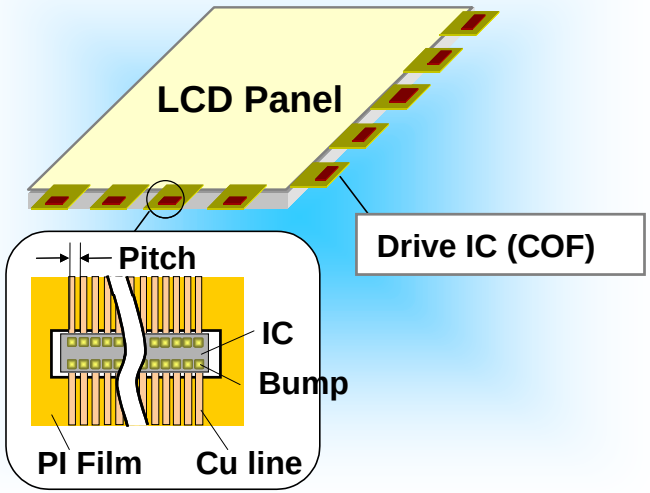
Proprietary Hybrid Material Technology

Any Hole Shape

High-precision Hole Processing

Next Generation Patterning Technology

LCD / IC Connection

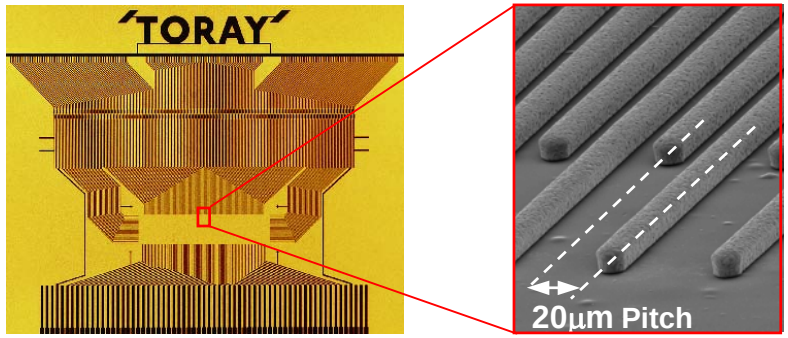


Trend in Connection Pitch of LCD Drive ICs

Year	2003	2004	2005	2006	2010
Pitch (μm)	35	30	25	20	10
Dimensional Tolerance (%)	±0.04		±0.02		±0.01

Conventional COF Technology → Newly Developed Technology

Dimensional Stability Limit



Excellent Properties

- Fine pitch of 20 μm or less
- Dimensional stability of ±0.001%

Technical Points

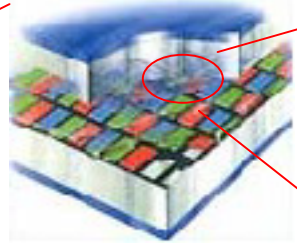
- Adopted semi-additive method, instead of subtractive method, which is useful for fine pitch Patterning
- Developed an innovative technology for flexible circuit manufacturing which controls dimensional change during patterning process

Development of Display Materials

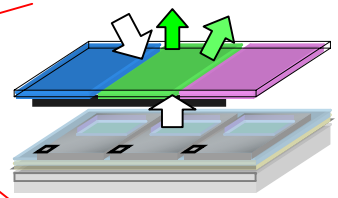
Materials Design / Coatings, Thin-film Formation / Photosensitization / Particle Dispersion / Processing Technology

LCD


Color Filters (CF)



Semi-transparent CF (TAF)

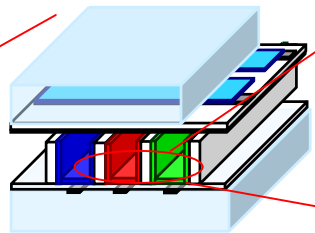


- BM Resin Paste
- Color Paste
- Slit Coatings

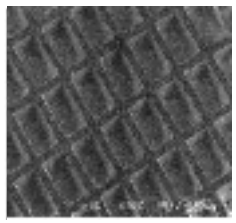
- Pigment Nanodispersion
- Large-area Coatings

PDP (plasma)

Rear Panel



Lattice Shaped Barrier Ribs

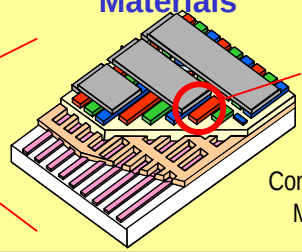


- Photo-sensitive Paste
- RGB Phosphor Paste
- Paste Coatings
- Firing

- Particle Dispersion
- 3D Pattern Formation Technology

Organic EL

Organic EL Materials



Red-light Emitting Material

Toray Material

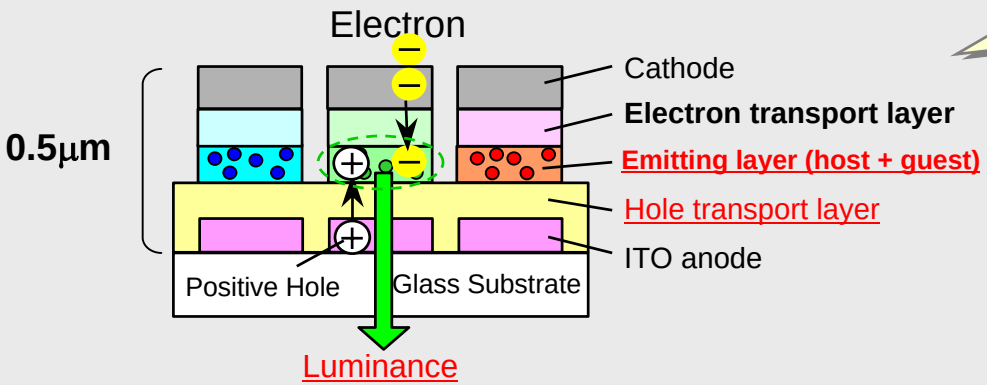
Conventional Material

- Organic RGB Emitting Materials
- Organic Carrier Transport Materials
- Mask Deposition / Sealing

- Control of Organic Semiconductor Properties
- Dry Patterning

Low Molecular Organic EL Luminescent Material

Organic EL Structure and Toray-developed Materials

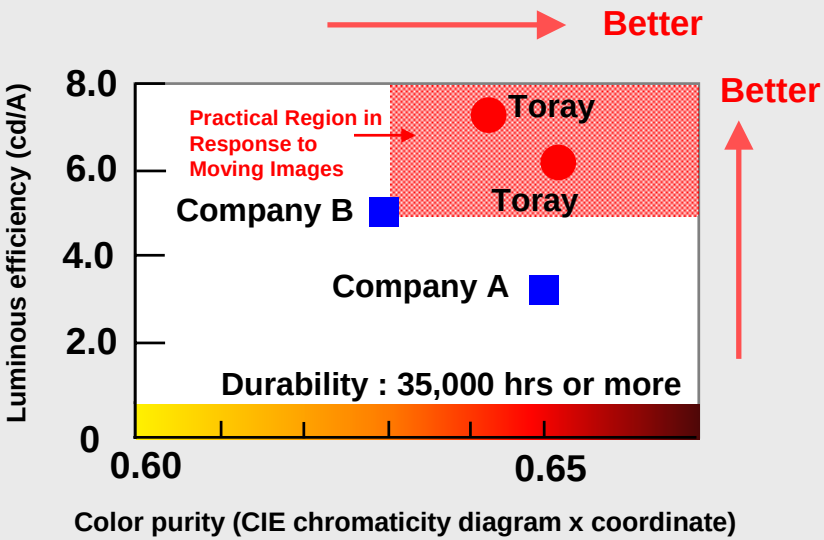


Electron Transport Material: Toray-E Series
enables low drive voltage and
maintenance of high color purity

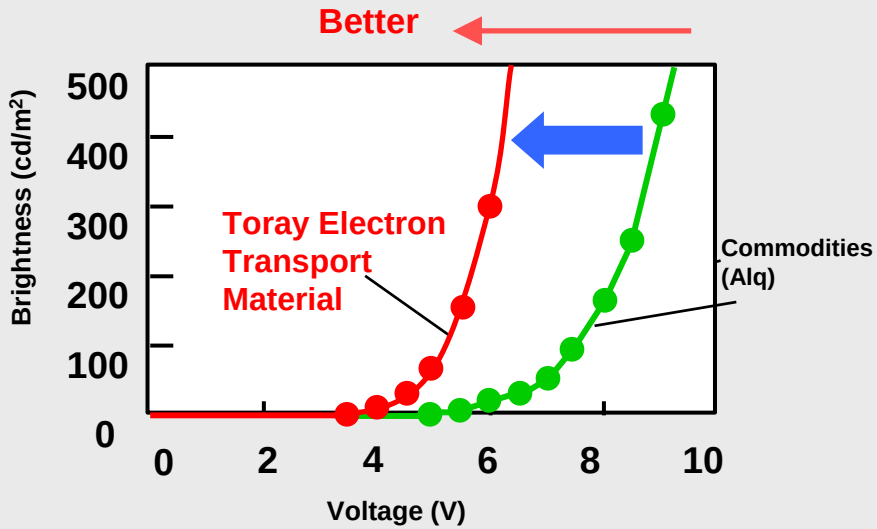
Red light emission materials
Host: Toray-H Series
Guest: Toray-D Series
High color purity, high efficiency, and long life

Properties of Toray Organic EL Materials

(red light emission + electron transport material)



Low drive voltage effect of electron transport material



Development of Films

Fundamental Technologies	Pursuit of Ultimate Performance	To IT-related Areas

Polymer Technologies

New Polymers

Polymer Design

Film Production Technology

Solution Film Production

Fusion Film Production

Molecular Structural Design / Control

Surface Design / Control

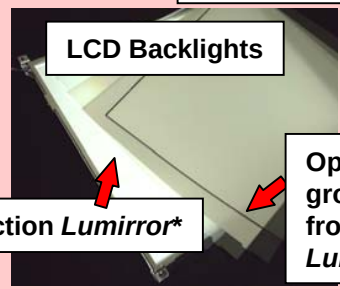
- **High Heat Resistance** → Polyimide film *"Kapton"*
- **High Rigidity** → Biaxially oriented aramid film *Mictron**
- **High Dimensional Stability** → Biaxially oriented PPS film *Torelina** film
- **Smoothness / Lubricity** → Biaxially oriented PET film *Lumirror** (High strength/high-definition surface)
- **Super Transparency** → Biaxially oriented PET film *Lumirror** (Super transparent)
- **Highly-reflective** → Biaxially oriented PET film *Lumirror** (Super white)

Information processing

Chip-type film capacitors made possible by *Torelina** film

Information Storage

Optical functional film groups formed from super-transparent *Lumirror**



Information Display

Optical functional film groups formed from super-transparent *Lumirror**

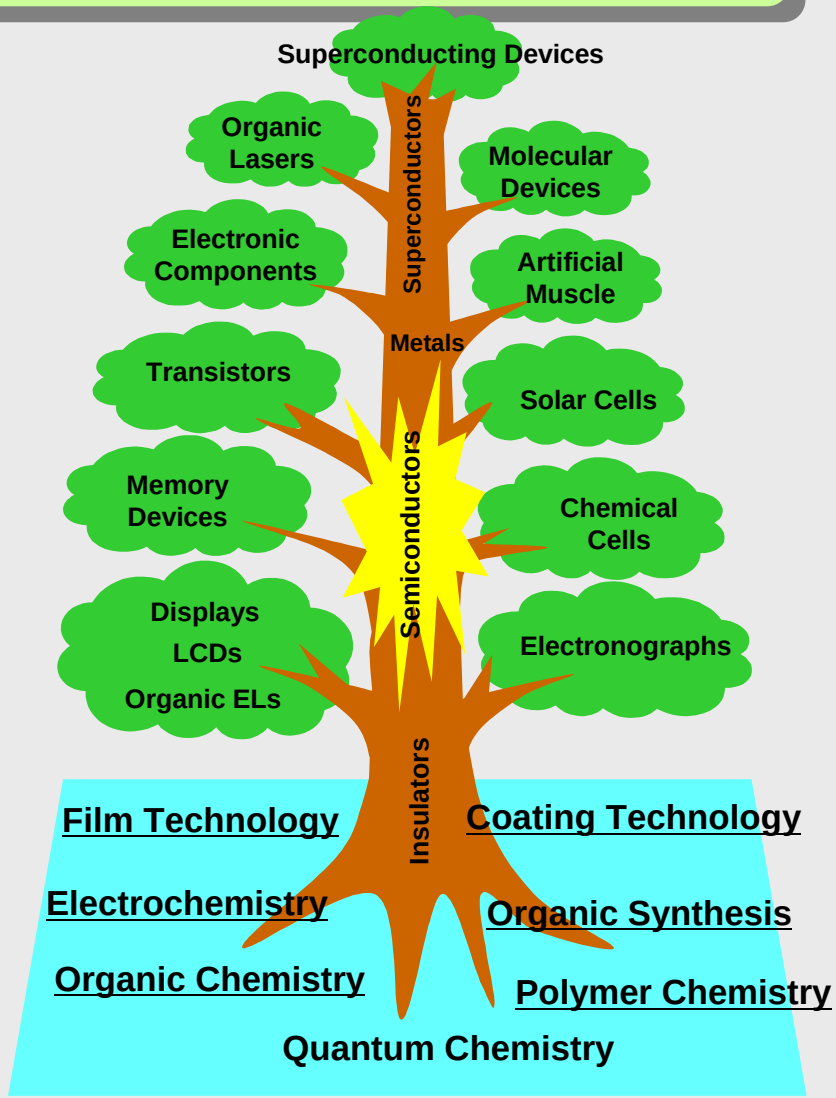
Super-white, high-reflection *Lumirror**

Focus on Optical Functional Films

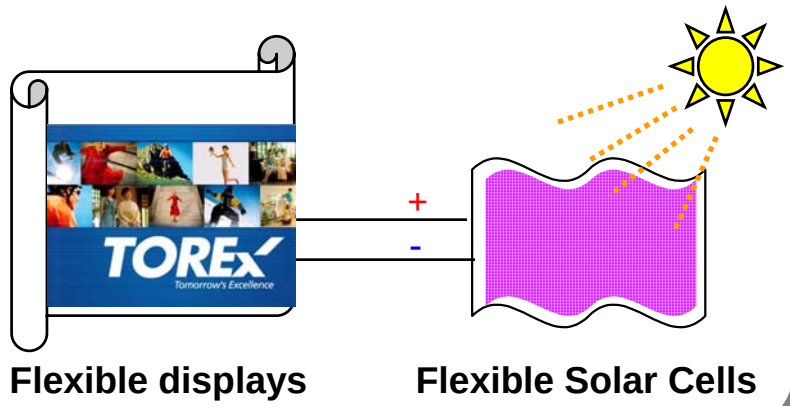
The products with an asterisk (*) or in quotes are registered trademarks of the Toray Group.

Organic Electronics

Expanded Application for Organic Electronic Materials



Application images



Direct Methanol Fuel Cells

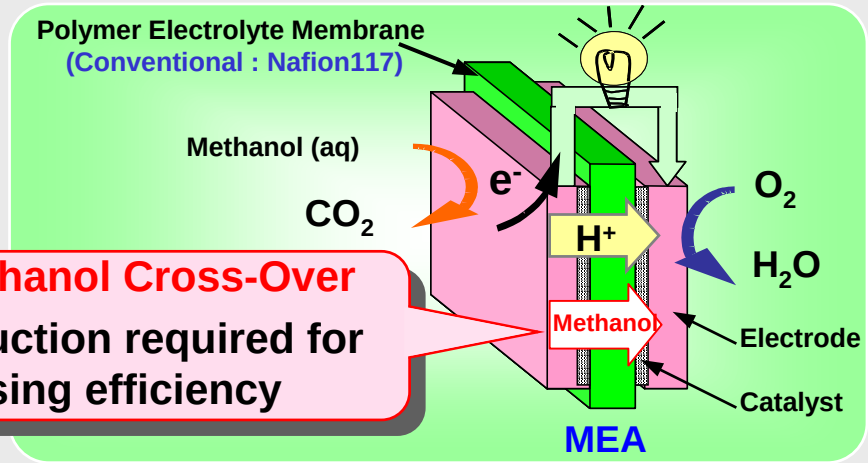
Current Performance

Power requirement : Available for Laptop PC

Durability : Major target

Prototype

Exhibited at Nikkei Nanotech Business Fair (9/29/04 to 10/1/04)



MCO: Methanol Cross-Over

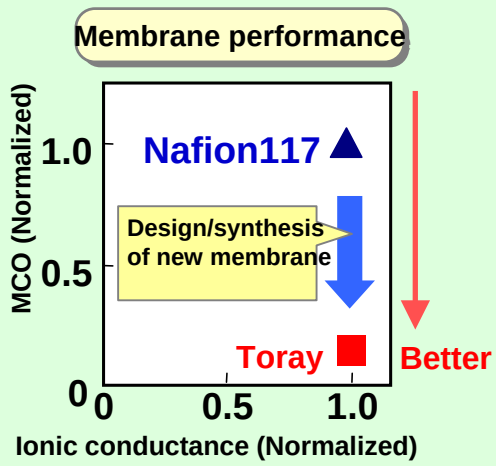
*** MCO reduction required for increasing efficiency**

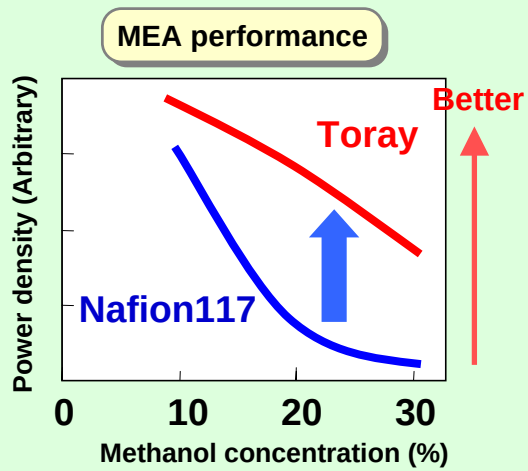
MEA: Membrane Electrode Assembly

Features of Toray MEA

- Electrolyte Membrane: MCO: 1/7 (vs. Nafion) [Ionic conductance: Equal to Nafion]
- Membrane/catalyst: Low interface resistance
- Catalyst layer: New design/new materials

High Power MEA





This work was supported by New Energy and Industrial Technology Development Organization (NEDO).

IT-related New Areas radio wave absorbing Paper

Development of radio wave absorbing new material in a paper-form

Electromagnetic Environment Control Materials for the Ubiquitous network society

For Electromagnetic Environment improvement in a wide-range of Wireless Systems, including Wireless LAN and collision warning/avoidance radar systems

Electromagnetic environment control is a key technology for building reliability in the information society

Areas/applications in which electromagnetic environment problems are a concern

Distribution/Transport
- IC tag
- IC card (Icoca, Suica, e-money)

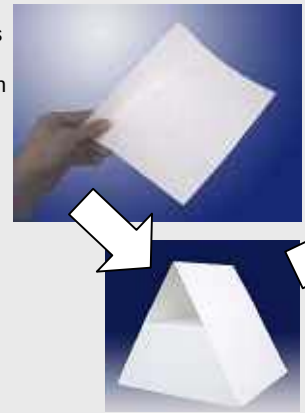
Bodily Protection
- Protection from mobile phone radio waves
- Internal/external pacemakers
- Medical devices (respirators, dialysis equipment, transfusion pumps, MRI)

Buildings/Public Facilities
- Office wireless LAN (prevention of information leaks)
- Hot spots between public spaces (stations etc.)
- PHS in hospitals

Automobiles
- On-board equipment (Car navigation ABS control)
- ITS (Intelligent Transport System)
- Hybrid cars (drive system)

Special Procurement
- RAM materials for airplanes
- Materials to prevent false images on naval radar
- Anechoic rooms

Application for Anechoic Rooms (Full-scale development in 2004)

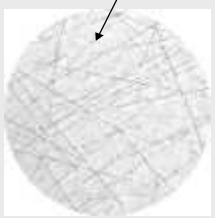


Example of Anechoic room construction in U.S.

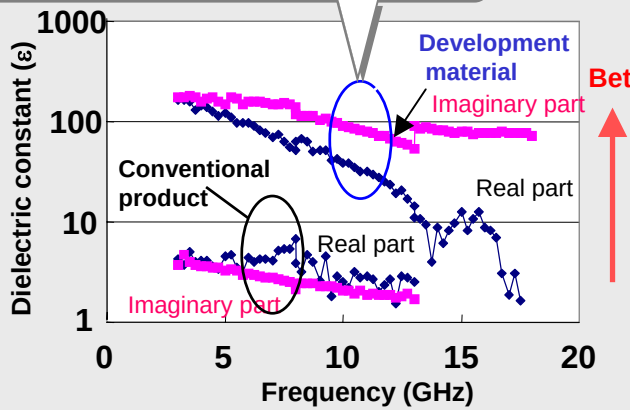
Material Characteristics

Dielectric constant (radio wave absorbing index) is upgraded to 10 to 100 times

Toray's fine conductive fiber



Photo



Development Plans and Application in 2005 and Beyond

For Offices :
Material for improving wireless LAN communication environments

For Airplanes, Trains, and Medical facilities :
Material for absorbing unwanted radio waves

For Intelligent Transportation Systems (ITS)
Material for improving electromagnetic environments

TORAY

Efforts in Environmental Areas

- Recycling-oriented Materials
- Environmentally Friendly Materials
- Global Warming Prevention Materials
  (Carbon Fibers Composite Materials)
- Improving Water Pollution
  (Separation Membranes for Water Treatment)

Development of Non-petrochemical Raw Materials

Toray is developing Non-petrochemical Raw Materials using Biotechnology

Non-petrochemical Raw Materials

Refining /Synthesis → Raw Material → Polymerization → Nylon, Polyester, Acrylics, Polyurethane, Others → Fibers, Textiles, Knitted Fabrics, Apparel

Plant-based Raw Materials

Biotechnology

1,3-propanediol (+TPA) → Polymerization → 3GT → Stretch Fibers

Lactic acid → Polymerization → Polylactic acid

Cellulose → Thermoplastic Cellulose Fibers

Example of Polylactic Acid Fiber

Photosynthesis

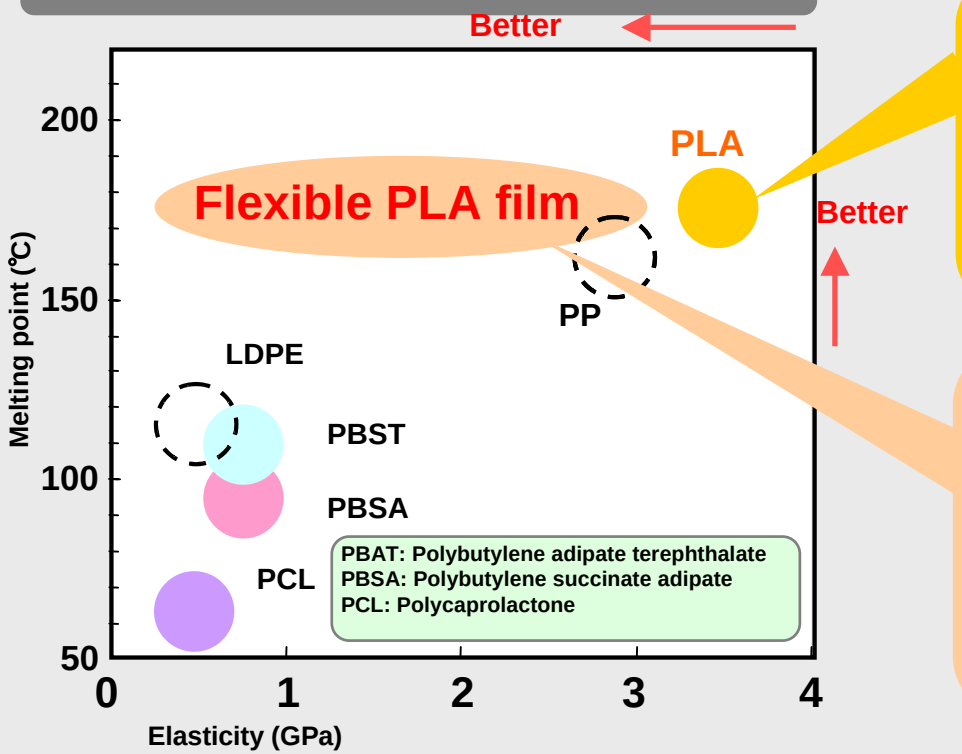
Water and carbon dioxide

Flexible Polylactic Acid Film

Featured on front-page of Nikkei Shimbun (7/3/04)

First in World to succeed in developing Fully Biodegradable Flexible Films made of Environment-friendly Plant-based Polylactic Acid (PLA: Polylactic Acid)

Comparison of Film Properties



100% PLA film

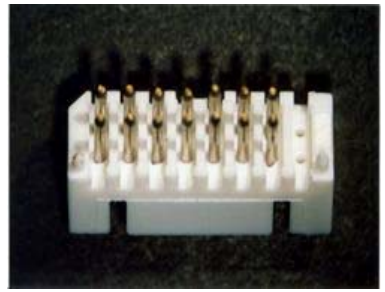
Flexible PLA film

Efforts in Environmentally Friendly Materials

Toray will continue to create Advanced Materials in the area of Environmentally Friendly Materials

Non-halogen Flame-resistant Resin | PBT | Nylon | ABS

Printer Fuser Cover



Electrical / Electronic Connectors

Non-halogen Flame-resistant Fiber | PET

New Flame-retardant Technology being developed

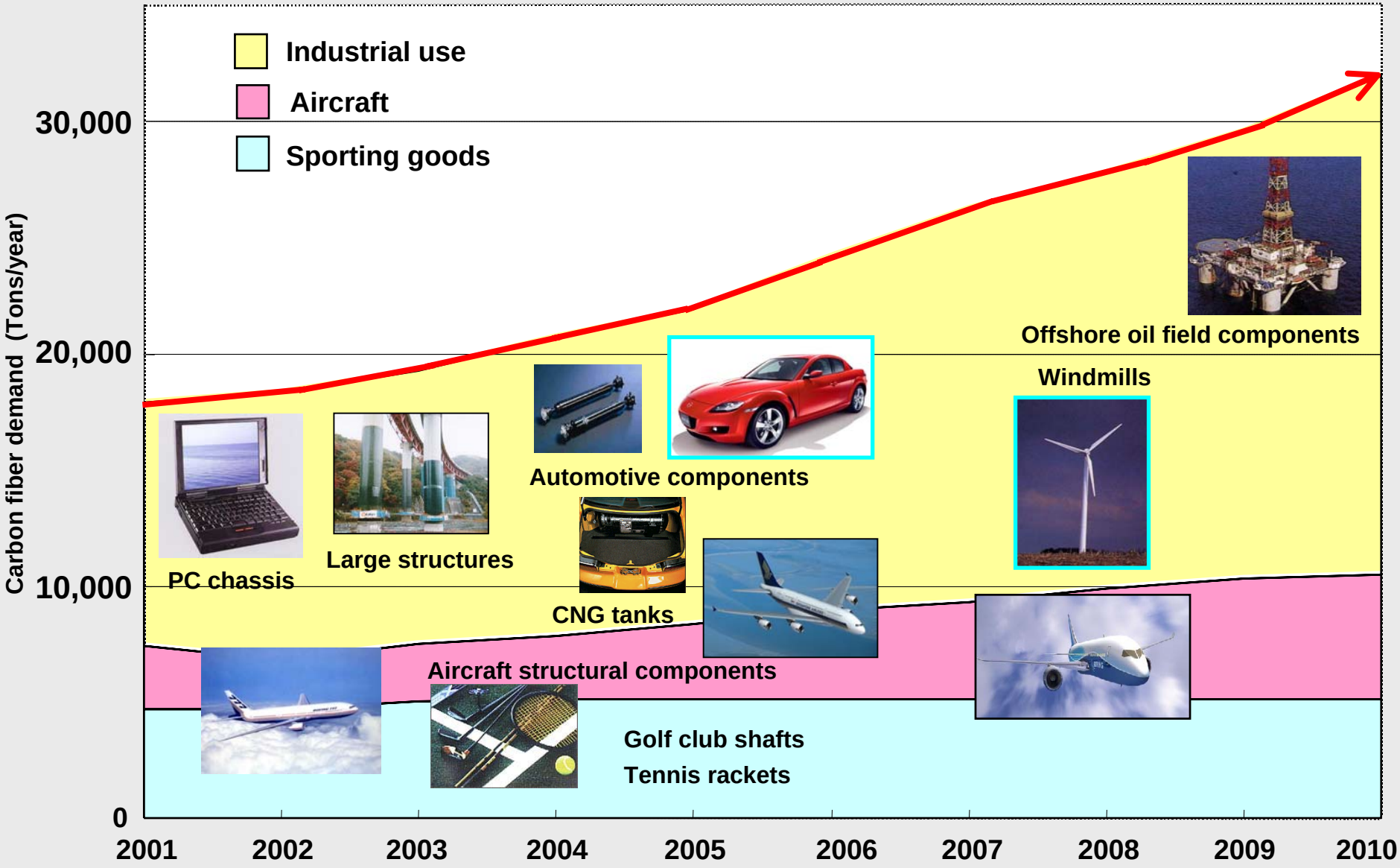
- Industrial materials
- Interior
- Apparel uses

Non-halogen Flame-resistant Film | PET

*Lumirror** ZV (Entered market in April 2004)

- Flexible printed base panels
- Adhesive Tapes
- Motor Insulation
- Flat Cables

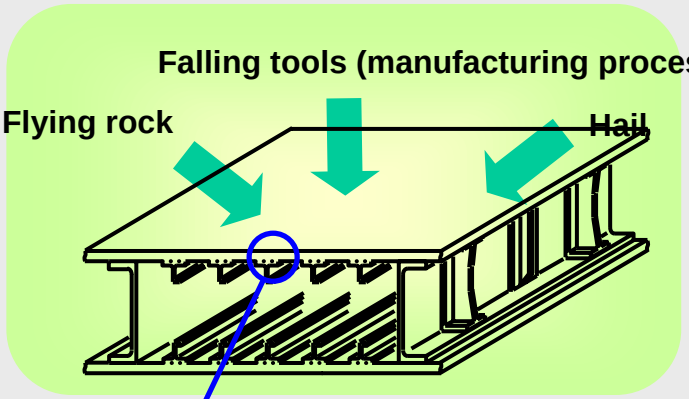
Forecast of the Carbon Fibers Market and the Expansion of its Applications

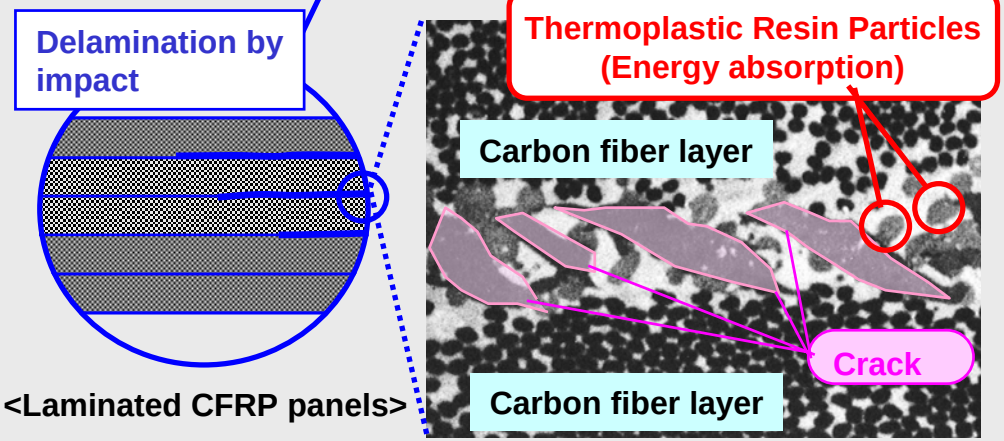


Improvement of Impact Resistance

Inter-particle Layer Reinforcement Technology

<External impact to the Aircraft Structure>



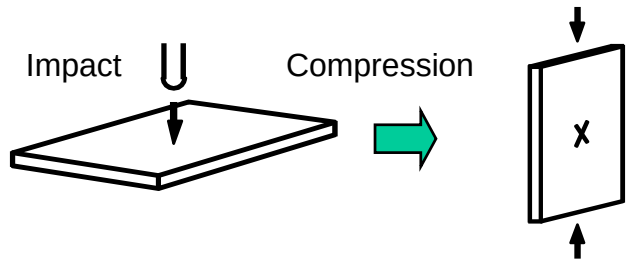


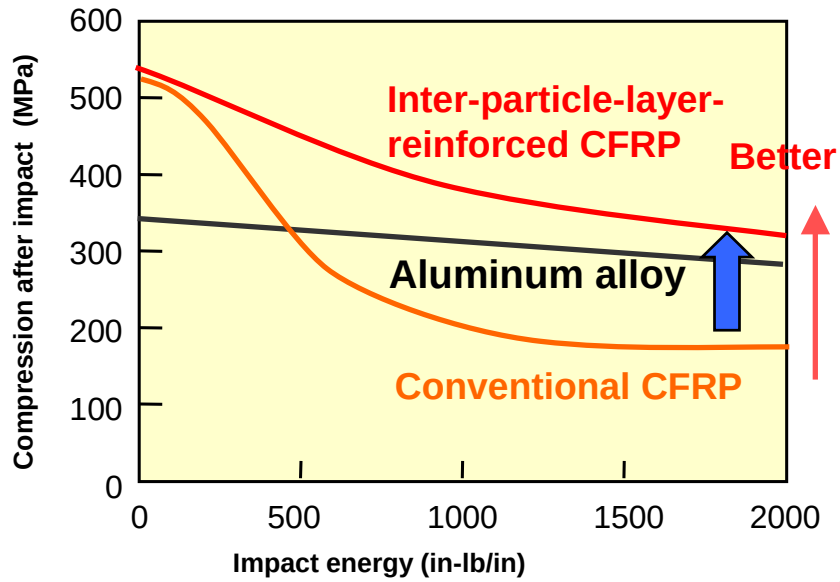
<Laminated CFRP panels>

<Inter-particle layer reinforcement >

Improvement of Impact Resistance by Interlayer Reinforcement

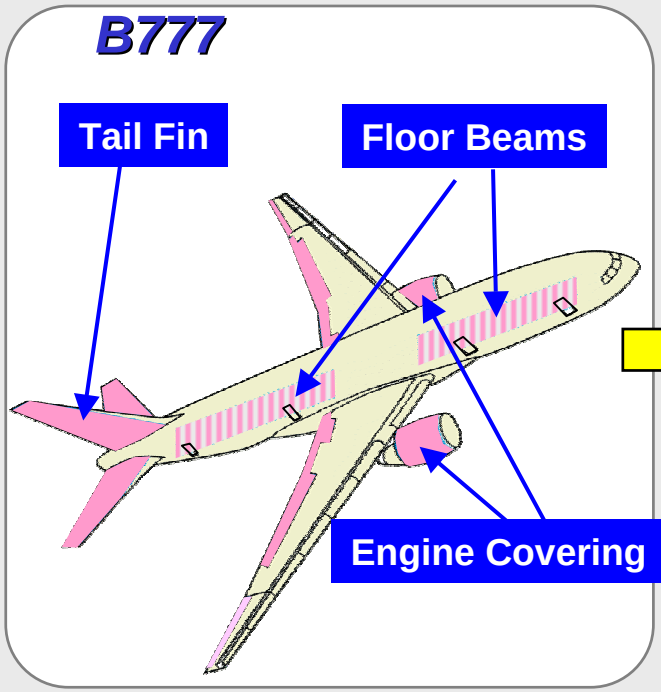
Compression after Impact

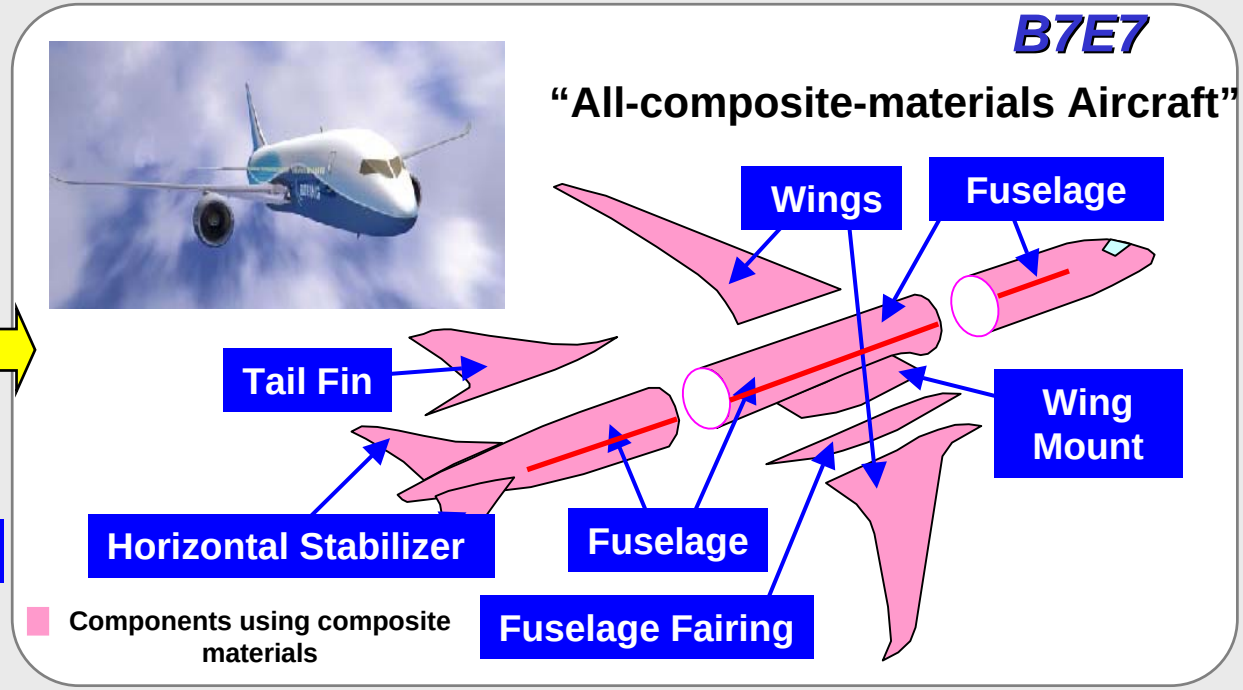




* High impact resistance by inter-particle layer reinforcement technology
  Employed in B777 and B7E7 primary structural materials

Expansion of Aircraft Application





Introduction	1982	1995	2008
Model	B767	B777	B7E7
Section using CFRP	Secondary structures	Primary structures (tail assembly etc.) Secondary structures	Primary structures (Main wings, tail assembly, and fuselage etc.) Secondary structures
CFRP utilization (wt%)	3	12	Approx. 50

* Orders received from Boeing: About 330 billion yen in 18 years
Further business expansion through the creation of advanced materials

Expansion of Automobile Applications

CFRP Effectiveness

Weight Decrease
Improved fuel efficiency →
Global warming countermeasure

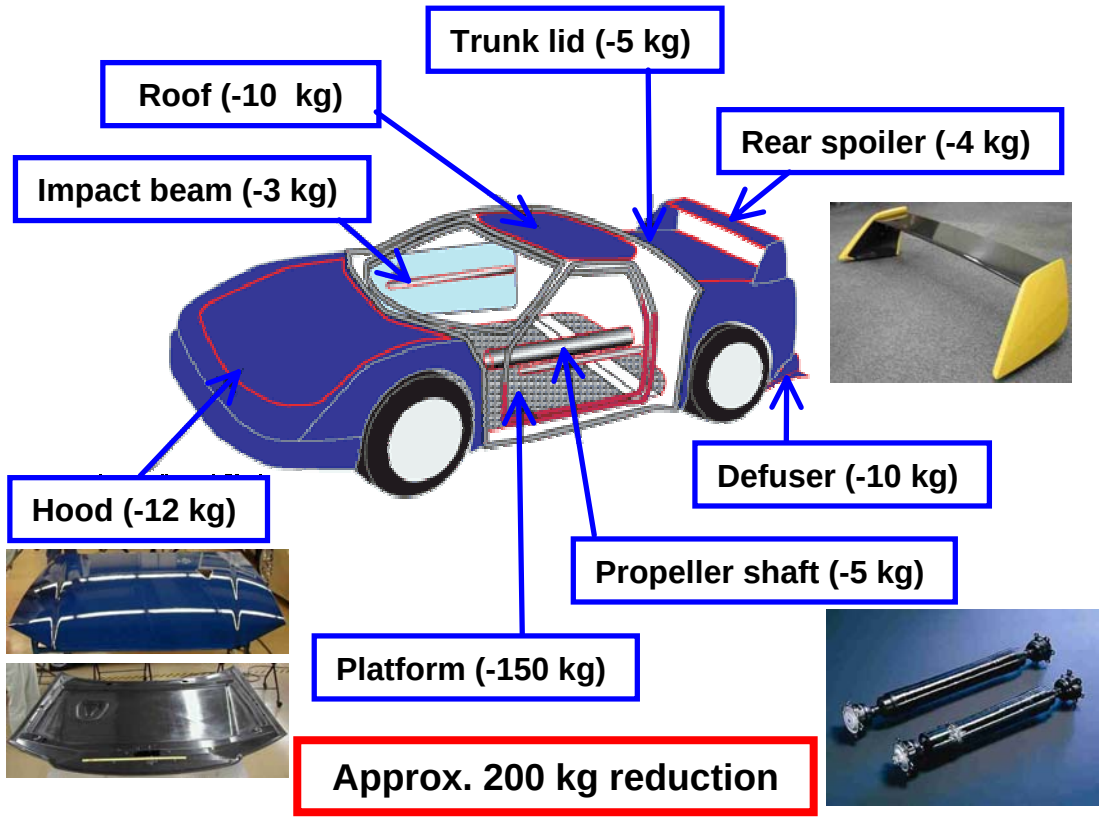
Improved impact safety (propeller shaft)
Impact energy absorption

Reduced assembly processes/cost
Modularization by integration

Improved running performance (propeller shaft)
Improved oscillation-damping/ increased eigenfrequency

Improved safety
Improved materials' fatigue properties

Approx, 50% Weight Reduction expected by use of CFRP



CFRP Application Sections and Weight Reduction

Figures in parentheses are comparisons with steel components, except for rear spoiler, which is compared with ABS resin

*"Innovative Global Warming Countermeasure Technology Program" (METI: 2003 to 2007)

New Developments in Water Treatment Business

Evolution of Membrane Separation Technology

Membrane	Area	Market Demand	1990	2000
RO	Ultra Pure Water	Low-pressure Operation	1.0 MPa	0.5 MPa
	Seawater Desalination	High Recovery rate High boron removal rate	40% Desalination Plants 	60% 90% → 95% → 99%
	Wastewater Reclamation	Low Fouling		Innovative Low Fouling
UF & MF	Tap water	Improved Durability	UF (PAN)	MF (PVDF)
	Wastewater Reclamation	Low Fouling Zero Emission	*Torayfil* -F* Hollow fiber membrane module 	Innovative Low Fouling MBR → Zero emission MBR

Toray's Technology Strengths

- Control of Nano-porous structure
- Surface Modifications
- High-Durability Polymers

Enhancement of Toray Group Water Treatment Business

Toray
Suido Kiko
Toray Engineering

July 2004
Consolidation of Domestic System Plant Business

Toray
-Basic materials (membrane elements and modules) business

Suido Kiko (Toray 51%)
- Overseas system plant business
- Domestic system plant business

(Toray's consolidated subsidiary)

Toray's Membrane Separation Technology for Water Treatment

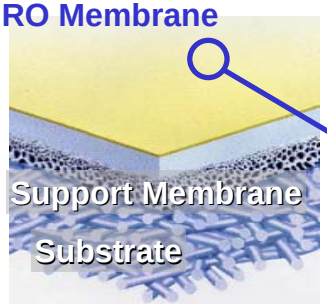
Strengthen Competitiveness by Development of High-performance RO Membrane

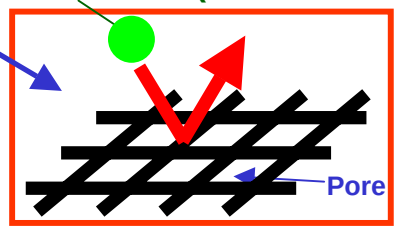
Efficient removal rate of boron (element known to kill citrus trees and cause infertility)

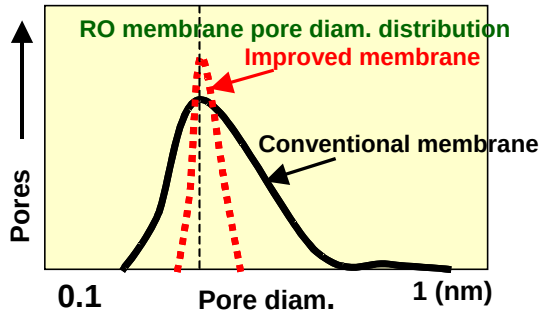
New technology points

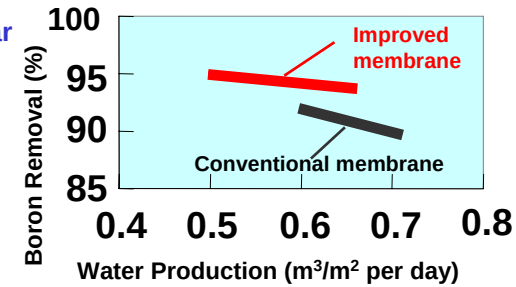
Increased membrane structure tightness by precise molecular design/ nanoprocessing technology

RO Membrane



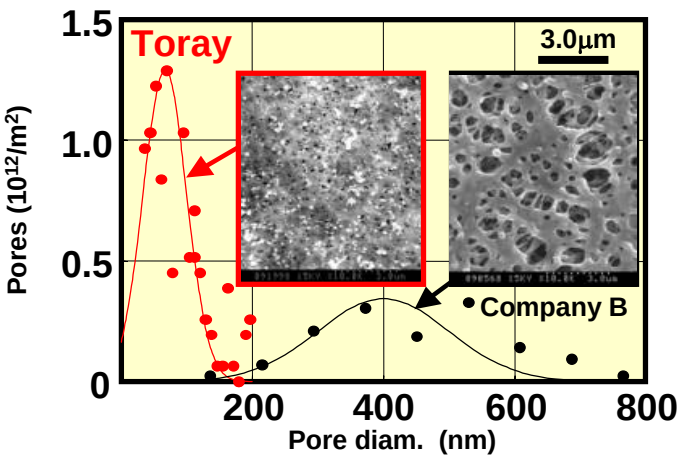






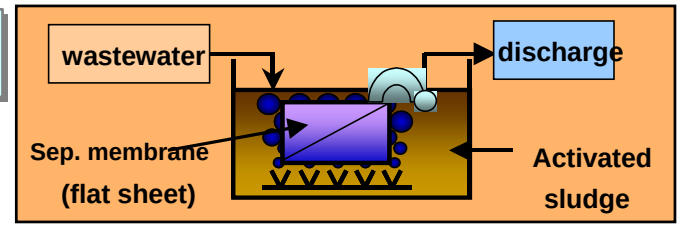
To be installed in a Large-scale Seawater Desalination Plant in Southeast Asia

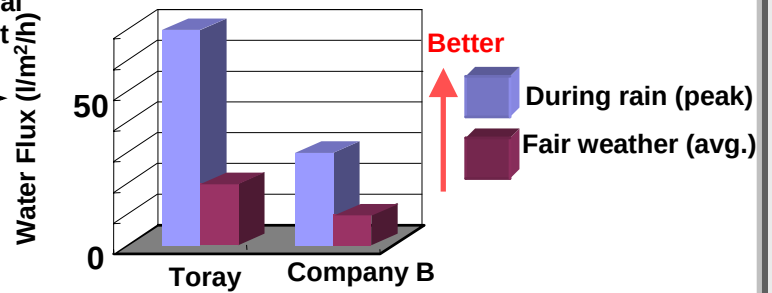
Membrane System for Wastewater Treatment (MBR: Membrane Bio Reactor)



Use of PVDF as Membrane Material For New membrane development

Nano-order control of membrane pore structure



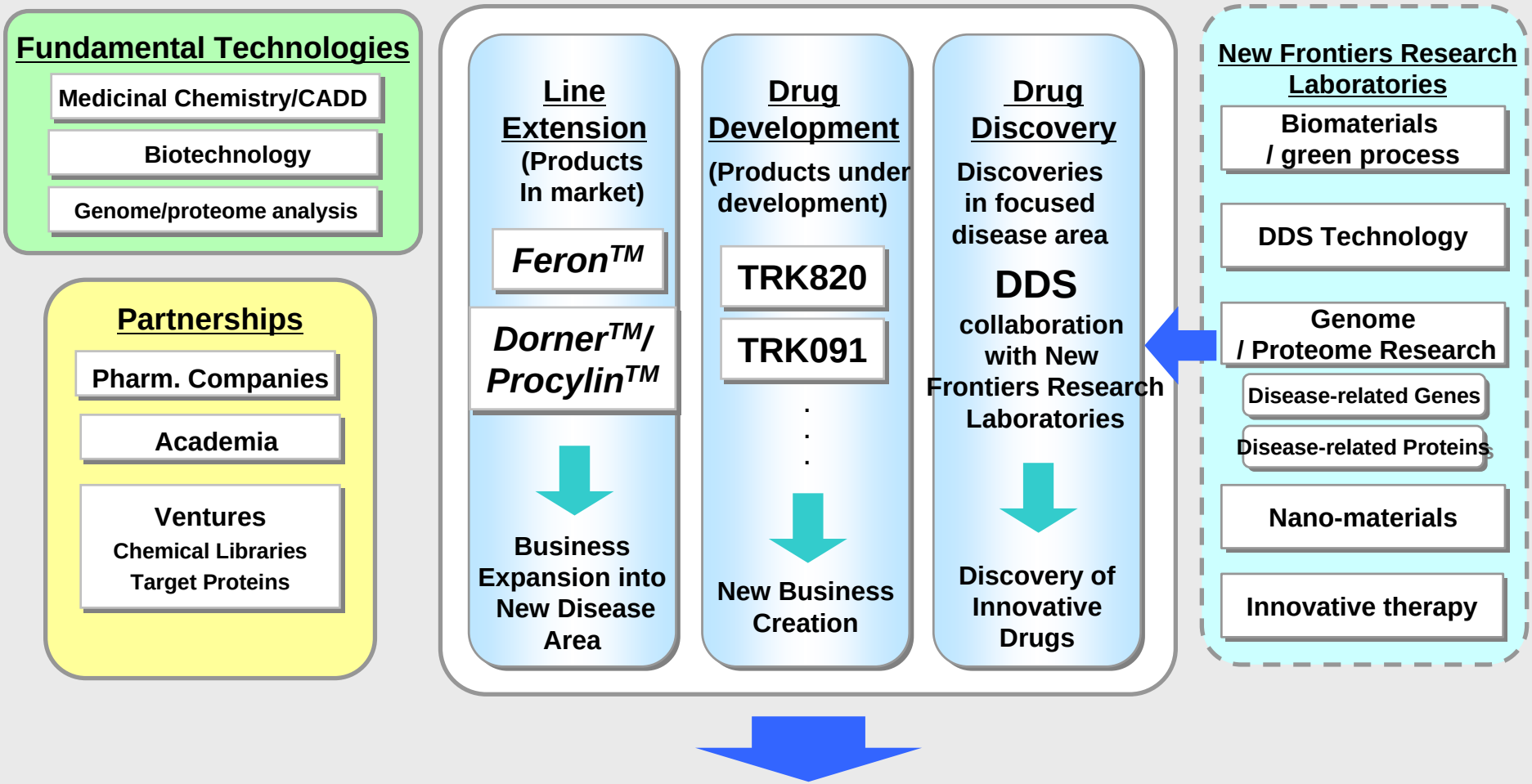


Highly appreciated by its excellent performance : water flux is two times larger than that of competitor's membrane in a pilot test in Europe

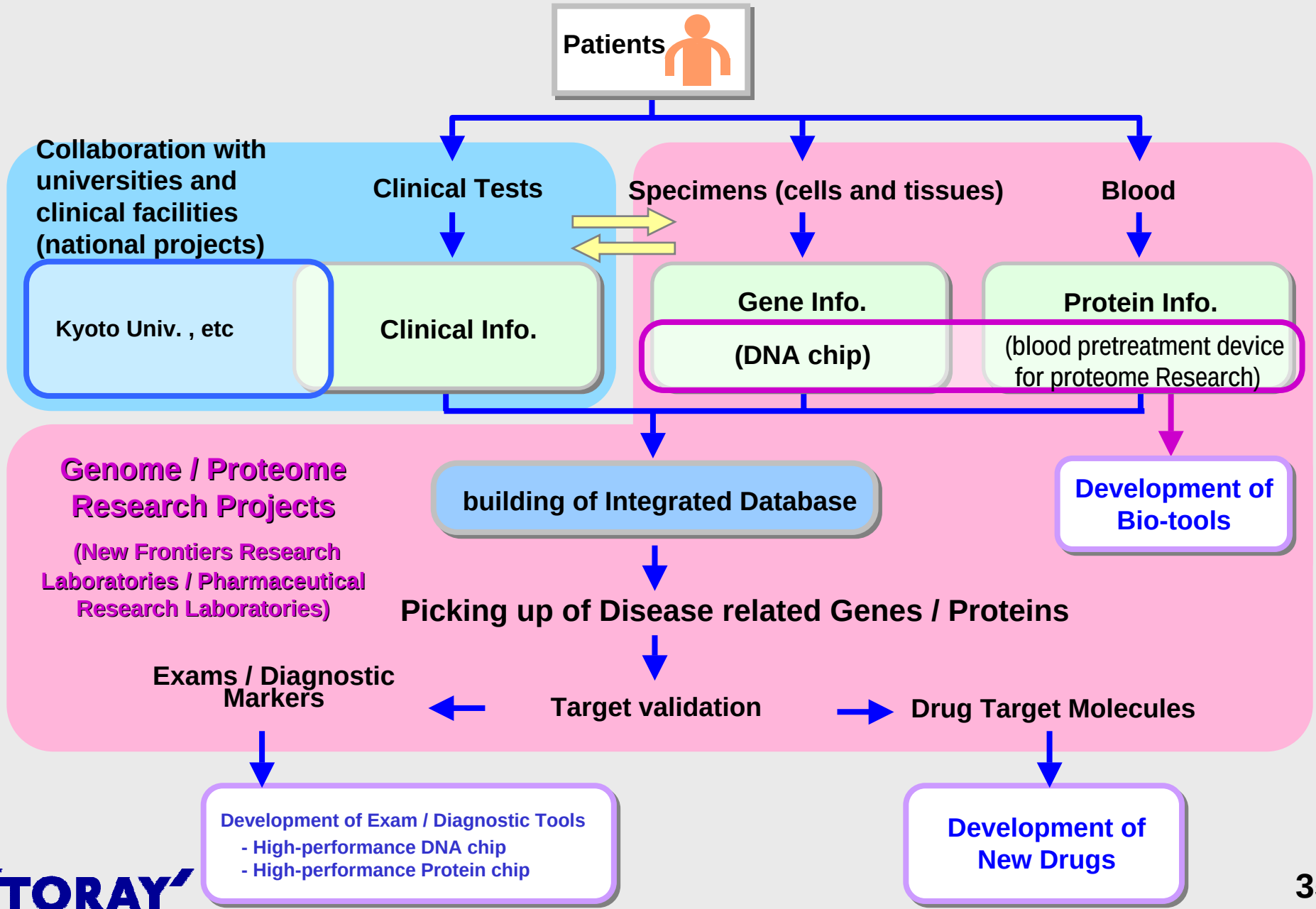
Enhancement in the Life Science Area

- R&D Strategy for Innovative Drugs
- Genome / Proteome Research Strategy
- Development of Next Generation DNA Chip

R&D Strategy for Innovative Drugs



Genome / Proteome Research Strategy



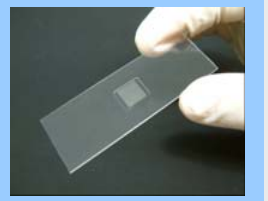
Development of Next Generation DNA Chip

Featured on front-page of Nikkei Shimbun (9/17/2004)

Development of Next Generation DNA chip

High-performance DNA chip

Toray



Increased sensitivity by 100 times compared to conventional chips

Contents conformation

DNA chips

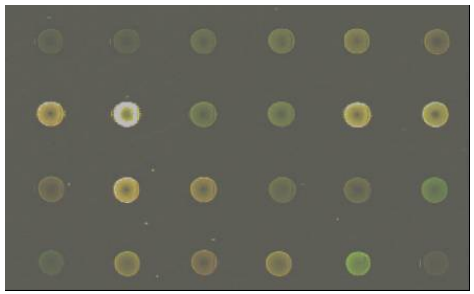
Toray ⇄ Kyoto Univ.

Disease-related gene information

Prof. Tsujimoto and others

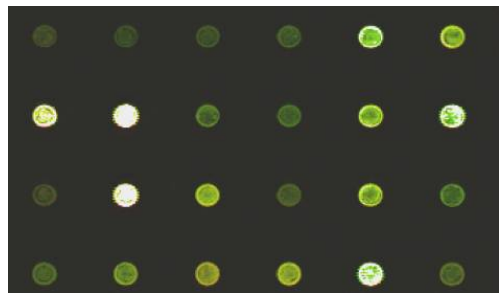
Gene diagnosis Chip

Gene Database for drug discovery



Conventional DNA Chip

High signal + Low noise



Next Generation DNA chip

- **High sensitivity** (Approx. 100-fold higher than conventional type)
- **Short handling time** (Approx. one-tenth of conventional type)
- **High quantitativeness**
- **High reproducibility**

* A part of this research is sponsored by NEDO “Bio-IT Integrated Device Development Project.”

Step-up of R&D Innovation

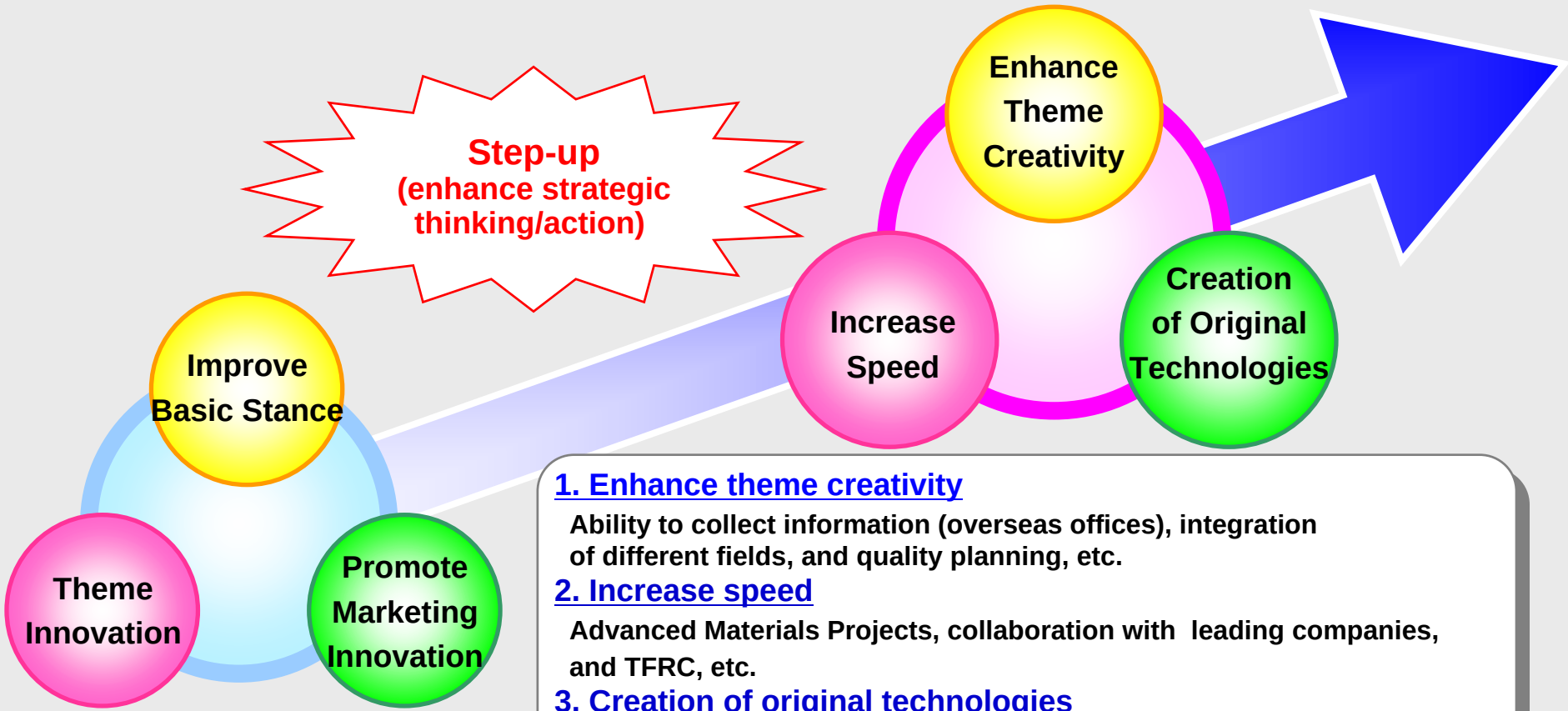
Project NT21
“Promoting R&D Innovation”

“Depart from Independent R&D”

Project NT-II
“Step-up of R&D Innovation”

“Strengthen R&D Collaboration / Integration (different fields / internal, external organizations)”

Step-up
(enhance strategic thinking/action)



1. Enhance theme creativity

Ability to collect information (overseas offices), integration of different fields, and quality planning, etc.

2. Increase speed

Advanced Materials Projects, collaboration with leading companies, and TFRC, etc.

3. Creation of original technologies

Venture companies and innovative combinations of fundamental technologies

Creation of Big Themes

Creation of big themes by strengthening market information gathering / sharing and R&D planning abilities

Strengthening market information-gathering /sharing abilities

Info source

Market

Media

Government

Industry

Academia

Sales

Toray Group

Multi-communication Activities

Staff

Research

Production

Technology

Strengthening R&D planning ability

Labs

Quality Planning Group

Market needs

Technology information

Fundamental technologies

Product planning Function evaluation

New product proposals

- Optical films
- Amenity
- IT
- Safety

big themes

Diverse planning activities

"Underground research"

CR Planning Dept.

Technical meetings with other leading companies

Large Theme Evaluation Committee

etc.

Creation of Original Technologies (Strengthening Technical Capabilities)

Constantly pursuing unique, new technologies and new sources for technology

Collaboration with Venture Companies

Collaboration with leading domestic / overseas venture companies in advanced materials businesses

Ventures	Area	Target Technology	Goal of Collaboration
Company A (Germany)	Pharmaceuticals	Computerized screening and drug evaluation of drug candidate compounds	Search for drug candidate compounds in genome drug discovery

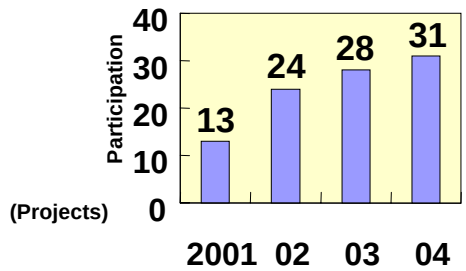
Strengthening collaboration with outside organizations

Collaboration with leading companies, public research organizations, and overseas influential universities and utilization of national projects

Example: RIKEN's Integrated Collaborative Research Program with Industry

- Team name:Integrated Materials Research Laboratory
- Research topic: Fundamental research on optical properties of composites containing nanoscale materials and Application for advanced textiles and films
- Research term: 4 to 5 years

Actively participate in national projects



Establishment of challenging themes

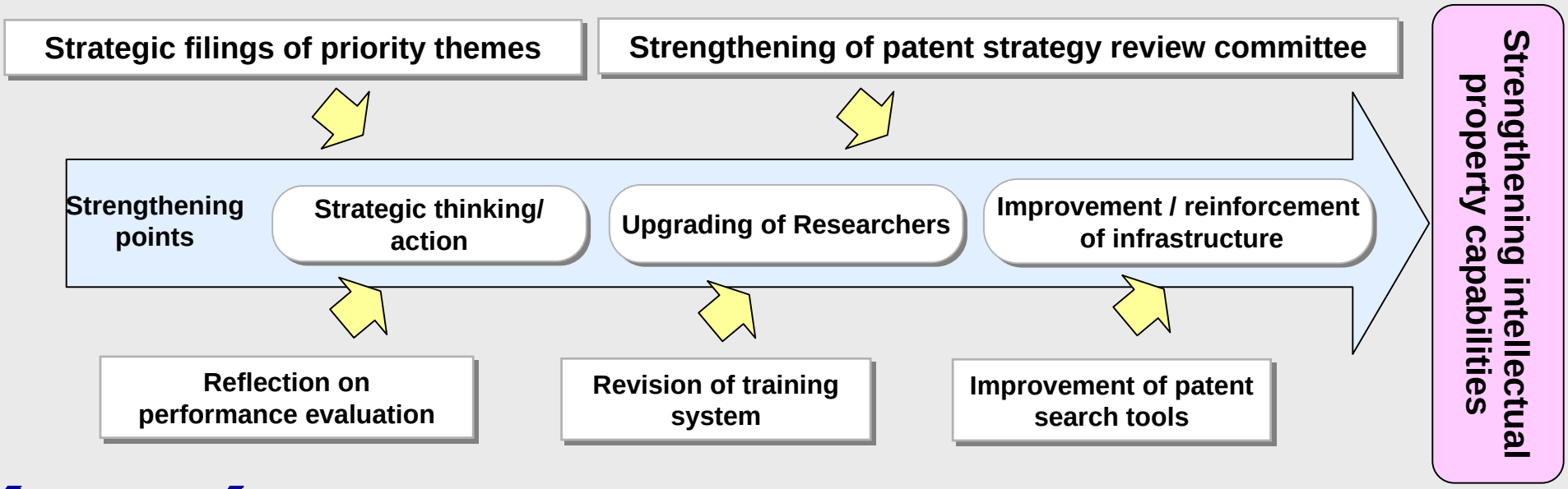
Challenge the subjects that will greatly contribute to our businesses and operations even if the technological hurdles are quite high.

Strengthen Intellectual Property Capabilities

Current status & issues

- Filings in past 5 years : 2,500 to 3,000
- Registrations in past 5 years : 650 to 900
- Focus on improving quality in the future

Efforts



Personnel Acquisition and Training/Revitalization

- Personnel must be acquired and trained to strengthen development capabilities
- Increase employment of capable experienced staff in development units of new business areas

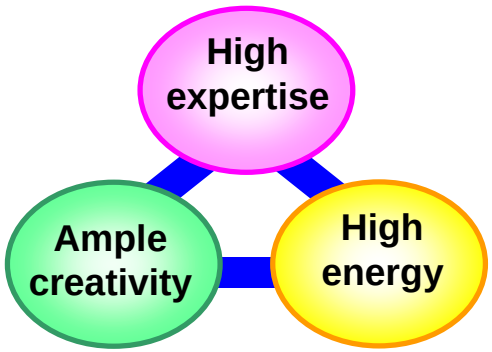
Personnel acquisition

- Early commercialization in Advanced Materials field
- Creation of new products/ technologies

- Increased hiring of experienced staff in new fields
- Continuation of periodic employment of new university graduates

- Building of information/human networks in academia/industry
- Strengthen individual recruiting and university rounds

Personnel training



- Selection and training of next leader candidates
- Active use of young talented researchers
- Active utilization of women
- Improvement/revitalization of Fundamental Technologies Conference

- Merit-based
- Objective management/assessment
- Objective/transparent assessment
- Rotation between research, development, and production
- Leadership training
- Manager training

Toray's Research/Technology Specialist System

(1) Research/Technology Specialist System

- Duty, qualification, and position system
- Promotion review for research specialists

(2) Research Fellow System

- Clear indication of researchers who are the model of specialists
- Creation of a culture devoted to research
- Creation of a culture where young researchers work hard to become specialists

(3) Director for specialty field, Senior Director/ Senior Director for specialty field System

- Advanced specialists in their field

(Equal to divisional director or equivalent effects/contributions expected)

Currently certified research fellows*

Year Author-ized	Specialty	Lab Affiliation
1999	Functional polymers	Functional Materials Research Laboratories
2002	Genome drug development	Pharmaceutical Research Laboratories
2003	Medicinal chemistry	Pharmaceutical Research Laboratories
2004	Polymeric structural design	Films & Films Products Research Laboratories
2004	Polymeric materials design	New Frontiers Research Laboratories
2004	Electronic materials properties	Electronic & Imaging Materials Research Laboratories

* Research specialists only (Certified by annual review)

→ **Management culture that encourages employees to strive to become advanced specialists**

Strengthening R&D Activities in China

<Basic Concept>

- Research, technological development and support for our businesses in China
- Basic polymer research by high-level Chinese researchers
- Promoting collaborations with Chinese universities and government research laboratories
  → Utilizing an open lab in Shanghai Branch Labs

Nantong R&D Center

Shanghai Branch Labs.

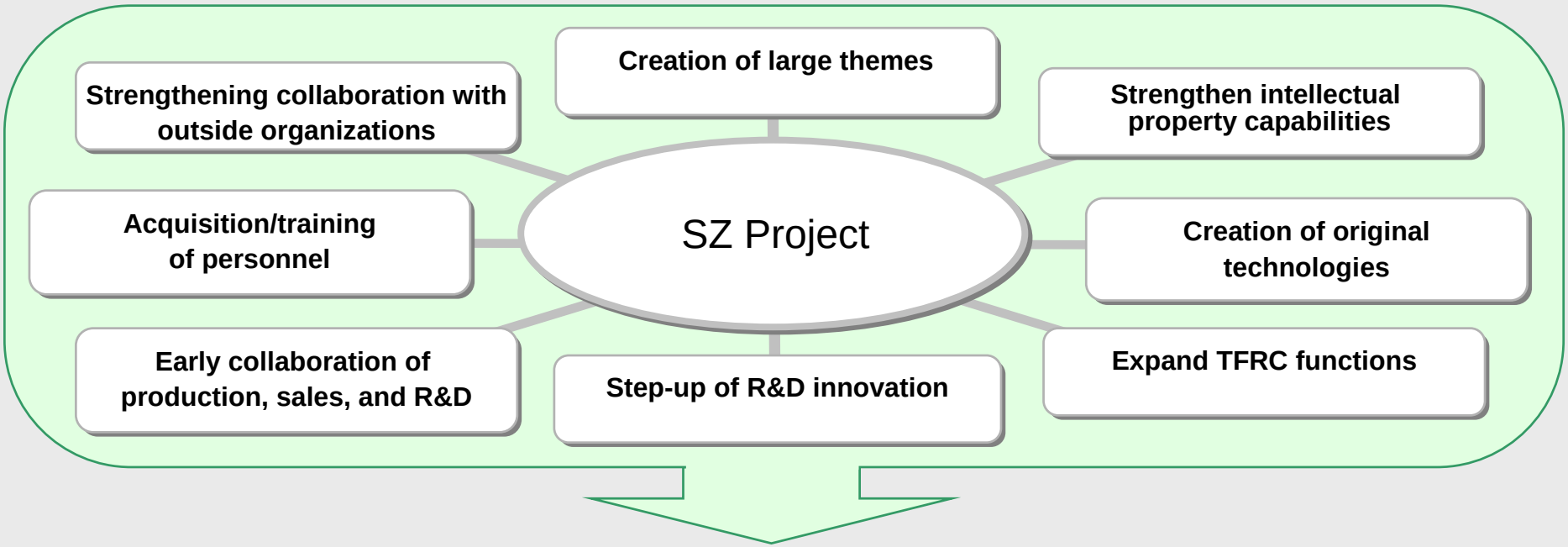
<Organization>

- TFRC
  - Nantong R&D Center
    - Polymers and fibers R&D Dept.
    - Textiles R&D Dept.
    - Industrial Materials R&D Dept.
    - (Water Treatment R&D Laboratory)
  - Shanghai Branch Labs.
    - Polymer Materials Research Laboratories
    - Water Treatment Research Laboratory
    - R&D Planning Dept.

Personnel Plan (TFRC)

2003 FY : ~ 50
2004 FY : ~ 150
↓
2008 FY : ~ 350

Speed-up with SZ Project



Speed-up

"Fuzzy" Front

Research

Technology

Production

Sales

Advanced Materials

Number one
First one
Only one