Business Strategies through The Establishment of the A & A Center in Nagoya Plant

Chiaki Tanaka
Executive Vice President and Representative Director
Toray Industries, Inc.

October 7, 2008
Contents

- Midterm Business Strategies “IT-2010” and the Creation of Advanced Materials

- The Era of Protecting the Global Environment and Toray’s EcoChallenge

- The Automobile Industry Entering a Great Revolutionary Era

- Concept for A & A Center and Restructuring of Nagoya Plant

- Expansion Plan for Automotive Business
Midterm Business Strategies, IT-2010

NT21
- Corporate Structure Reinforcement - defensive management postures -
- Breakaway from Crisis -

NT-II
- Offensive management postures -
- Establish foundation for further growth -

IT-2010
- Management based on Innovation and Creation -
- Challenges for further growth -

Toward a Global Top Company of Advanced Materials

Goals in and around 2010
- Net sales ¥1,800 billion
- Operating income ¥150 billion
- Operating income to net sales ratio 8.3%
- ROA : 8%
- ROE : 11%

2002 April
2004 April
2006 October
Around 2010
### Basic Strategies

(Transformation to a highly profitable business group)

| 1. Transforming to a highly profitable business group | **Transform to a highly profitable business group while continuing business expansion**  
① 5% annual growth in net sales  
② 10% annual growth in operating income  
**“5-10 Growth Plan”**  
**Improving capital efficiency**  
① ROA: over 8%  
② ROE: over 11% around 2010 |
|---|---|
| 2. Expanding Strategically Expanding Businesses (profit growth driver) | **Increase profit by expanding Strategically Expanding Businesses**  
(IT-related products and Carbon Fiber Composite Materials) while securing stable profit by Foundation Businesses |
| 3. Expanding Strategically Developing Businesses (next profit growth driver) | **Develop strategically next generation profit growth driver businesses after 2010** (Life Science, Water Treatment, Environmental friendly businesses) |
| 4. Advancing business structure reform | **Advance business structure reform by expanding Strategically Expanding Businesses and Strategically Developing Businesses**  
① Double net sales in Strategically Expanding Businesses and Strategically Developing Businesses around 2010  
② Expand their ratio of net sales from the current 25% to 40% around 2010 |
| 5. Expanding advanced materials | **Expand advanced materials sales in every segment and increase their ratio of net sales**  
① Double net sales in advanced materials around 2010  
② Expand their ratio of net sales from the current 30% to 50% around 2010 |
## Basic Strategies
(Expansion of advanced materials in 4 major growing business fields)

### Aim for business expansion mainly in advanced materials by providing cross-organizational solutions to the 4 major growing business fields.

| Information / Telecommunications / Electronics | Business expansion in the growing market of digital network-related products including flat panel display televisions, cellular phones, and personal computers  
| Development and sales expansion of innovative products through vertical business integration with key customers  
| Strengthen competitiveness through integrated operations from plastic/films materials to components |
| Automobiles / Aircraft | Development of products to meet expanding markets in hybrid cars and car electronics  
| Expansion of application parts by widening advanced functional availability of carbon fiber composite materials and engineering plastics  
| Aggressive capacity expansion to meet the growing demand for carbon fiber composite materials |
| Life Science | Conclusive launch of new drugs which is under development and further expansion of new drug pipelines  
| Development and commercialization of high value-added medical devices  
| Creation of innovative bio-tools through bio/nano-technological integration |
| Environment / Water-related / Energy | Development of new applications for fibers & textiles, plastics and films using such non-petrochemical raw materials as polylactic acids  
| Global expansion of water treatment businesses with a core of high-performance separation membranes  
| Development of new materials for next generation energy systems including solar cells, fuel cells, and wind power generation |
Toward a Global Top Company of Advanced Materials

“Create advanced materials that change the future”
That is Toray’s Nano-technology

Toray Core Technologies
Organic synthetic chemistry
Polymer chemistry
Biotechnology
Nano-technology

New Properties Emerge
New Value “Nano-effect”
Dramatic improvement in properties

Nano-material
Nano-structure design control
Nano-surface-treatment
Nano-process (nano-processing)
Nano-analysis

CNT
Nano-particles (nano-dispersion)
Nano-alloy*
Nano-composite
Chemical modification
Nano-coating
Nano-imprint
Nano-laminates
Nano-shape observation
Nano-structure analysis/composition analysis

Innovation of key materials
Fibers & Textiles
Nanofiber
Resins
Nanolaminated film
Chemicals
High-toughness nano-alloy*
(Zeolite)

Expansion of four growing business fields
Information / Telecommunications / Electrics
Film for data storage, LCF, PDP
Automobiles / Aircraft
Carbon fiber, impact-absorbing Aircraft
Life Science
Artificial kidney, DNA chip
Environment / Water-related / Energy
PLA products, water-treatment membranes, fuel cell

* nano-alloy* is one of Toray’s trademark

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## Business Culture of Toray Technology Development

A business culture that pursues the ultimate, challenge in “Innovation of technologies,” and create innovative technologies

<table>
<thead>
<tr>
<th>Area</th>
<th>Ultimate Themes</th>
<th>Objectives</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibers &amp; Textiles</td>
<td>Nano-fiber</td>
<td>Fineness of fiber diameter</td>
<td></td>
</tr>
<tr>
<td>Resins</td>
<td>Polymer-alloy</td>
<td>Polymer dispersion size</td>
<td></td>
</tr>
<tr>
<td>Films</td>
<td>Multi-layer film</td>
<td>Thinness of film layers</td>
<td></td>
</tr>
<tr>
<td>Carbon Fiber Composite Materials</td>
<td>Carbon fiber</td>
<td>Strength and rigidity</td>
<td></td>
</tr>
<tr>
<td>Electronic &amp; Information Materials</td>
<td>High-density mounting board</td>
<td>Processing accuracy of wiring pitch</td>
<td></td>
</tr>
<tr>
<td>Health care</td>
<td>DNA chip</td>
<td>Structure design control of nano-columnar</td>
<td></td>
</tr>
<tr>
<td>Water Treatment</td>
<td>High boron-rejection membrane</td>
<td>Pore size control of RO membranes</td>
<td></td>
</tr>
<tr>
<td>Engineering Development Center</td>
<td>Realization of innovative technologies through creation of new processing and establishment of process for mass-production</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Strength and Rigidity**
  - Glass: 65 GPa
  - Steel wire: 200 GPa
  - Nylon fiber: 5 GPa
  - Aramid fiber: 55 GPa

- **Columnar Structure**
  - $100 \mu m$
  - $20 \mu m$

- **Polymer model**
  - Co-polymerized PET

- **Nano-columnar**

- **Hair Ultrafine-fiber**
  - $20 \mu m$

- **IC bonding area**
  - $20 \mu m$
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Various Global Environmental Issues

Urgent response to various global environment issues is required

Global warming / Extreme weather

Acid rain

Air pollution

Desertification

Ozone layer depletion

Biodiversity loss

Sea pollution

Oil exhaustion

Forest loss

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Global Environmental Issue Initiatives by the Industrial World

Responses to GHG reduction…
(GHG: Green House Gas)

- Global warming
- Extreme weather
- GHG increase
  - use of fossil fuels
  - deforestation, etc.

Ensuring food, water, energy
Protection from natural disasters / reconstruction plans

CO₂ reduction from a Carbon-Balance perspective

* quantification value of CO₂ balance over total product-life cycle

- Mining of natural resources / refinement
- Production
- Use
- Disposal

Contribute to GHG reduction during mining / refinement / production / use / disposal

Globally sustainable recycle-oriented society (combine “environment” and “economy”)

★ Environment-responsive R&D is substantial
★ Accelerate innovation based on multifaceted integration

Key points
- Energy conservation / New energy resources
- Non-petrochemical raw materials
- Water-treatment / Air-purification / Environmentally friendly
- Recycle

Chemistry will save the earth

Global Environmental Issue Initiatives by the Industrial World

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(GHG: Green House Gas)

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- Extreme weather
- GHG increase
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  - deforestation, etc.

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Chemistry will save the earth
<table>
<thead>
<tr>
<th>Energy conservation</th>
<th>Fibers &amp; Textiles</th>
<th>Films</th>
<th>Resins Chemicals</th>
<th>Carbon Fiber Composite Materials</th>
<th>IT-related Products</th>
<th>Water Treatment / Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High-efficiency manufacturing process, energy-saving forming technology/energy-saving process of membranes, modernizing of in-house power generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-saving building materials (insulation/heat shield/heat exchange material)</td>
<td></td>
<td>Weight-saving of automobiles/aircraft</td>
<td></td>
<td>Advanced composite materials for automobiles/aircraft</td>
<td>Advanced EL materials</td>
<td>Membrane treatment method Water treatment</td>
</tr>
<tr>
<td>New energy resources</td>
<td></td>
<td>Battery materials</td>
<td></td>
<td>Wind-power generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Materials for lithium-ion battery / fuel cell</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Materials for solar cell</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-petrochemical raw materials (bio-chemicals)</td>
<td></td>
<td>Cellulose fiber (solvent-free)</td>
<td></td>
<td>Chemical process with membranes</td>
<td></td>
<td>Membrane Bioreactor</td>
</tr>
<tr>
<td>Water treatment/Air-purification/Environmentally friendly</td>
<td></td>
<td>Heat resistant bag filter</td>
<td></td>
<td>CNG/H2 tank</td>
<td>Waterless printing plate</td>
<td>Water treatment/Modules/Systems</td>
</tr>
<tr>
<td>Water treatment/Air-purification/Environmentally friendly</td>
<td></td>
<td>Eco-process of man-made suede</td>
<td></td>
<td>Film for coating alternatives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycle</td>
<td></td>
<td>Halogen-free flame retardant materials</td>
<td></td>
<td>BM resin</td>
<td></td>
<td>Air filter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PET, N6, PBT, ABS, PPS</td>
<td></td>
<td>DMSO</td>
<td>CFRP</td>
<td></td>
</tr>
</tbody>
</table>
**EcoChallenge**

**[Energy conservation] CO₂ Reduction with Carbon Fibers: Aircraft**

**<Precondition>**
- **Aircraft**: Midsize passenger aircraft (Boeing 767)
  - Domestic line specification
- **Flight**: Domestic line (Haneda ⇔ Chitose; 500 miles)
- **Lifetime operational track**: 2,000 flights/yr, 10 years
  - (Source: ANA)
- **CFRP in use**: CFRP50% applied (composition of Boeing 787)
  - 20% lighter in weight (over conventional aircraft)

**<Cooperation>**
- Tokyo University, Pro. Takahashi / Rinoie
- Kobe Yamate University, Pro. Feuerherd
- ANA, Boeing

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**Per one aircraft**

- **Reduction effect**: ▲27,000 tons (7%)
- **CO₂ [ton/(unit-10years)]**
  - **Conventional Aircraft**
    - Materials & parts production: 700 t / Assembly: 3,800 t
    - Total: 390,000 t
    - **CFRP used Aircraft**
      - Materials & parts production: 900 t / Assembly: 3,000 t
      - Total: 364,000 t
      - **Disposal**: 0 t

**CO₂ [ton/(unit-10years)]**

- ▲2,700 tons CO₂ reduction (unit-year)

**Per ton of carbon fiber**

- **Materials & parts production**: 700 t / Assembly: 3,800 t
- **Assembly**: 3,800 t
- **Total**: 395,000 t
- **Disposal**: 0 t

- **Total**: 395,000 t

- **CFRP used Aircraft**
  - Materials & parts production: 900 t / Assembly: 3,000 t
  - **Total**: 368,000 t
  - **Disposal**: 0 t

- ▲1,400 tons

**20 tons**

**▲140 tons CO₂ reduction/(CF1ton-year)**

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<Precondition>
Vehicle weight: 1,380kg\(^*1\) (gasoline-car, 4 doors, FF)
Actual mileage: 9.8km/l \(^*1\)
Lifetime mileage: 94,000km\(^*2\) (average age 10 years)
(Source: \(^*1\) JAMA, \(^*2\) MLIT)

CFRP in use: CFRP17% applied, 30% light in weight
(over conventional automobile)

<Cooperation>
Tokyo University, Pro. Takahashi
Kobe Yamate University, Pro. Feuerherd
Toyota Motor Corp.

Per one vehicle
Reduction effect: 5 tons (16%)

<table>
<thead>
<tr>
<th></th>
<th>CO(_2) [tons / (unit-10years)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional cars</td>
<td>3.9 t</td>
</tr>
<tr>
<td></td>
<td>1.2 t</td>
</tr>
<tr>
<td></td>
<td>0.8 t</td>
</tr>
<tr>
<td></td>
<td>5.1 t</td>
</tr>
<tr>
<td></td>
<td>26.0 t</td>
</tr>
<tr>
<td></td>
<td>0.3 t</td>
</tr>
<tr>
<td>Total</td>
<td>31.5 t</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CFRP used car</th>
<th>CO(_2) [tons / (unit-10years)]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.2 t</td>
</tr>
<tr>
<td></td>
<td>0.3 t</td>
</tr>
<tr>
<td></td>
<td>5.1 t</td>
</tr>
<tr>
<td></td>
<td>20.2 t</td>
</tr>
<tr>
<td></td>
<td>0.3 t</td>
</tr>
<tr>
<td>Total</td>
<td>26.5 t</td>
</tr>
</tbody>
</table>

Per ton of carbon fiber
Volume of CO\(_2\) emitted during carbon fiber manufacture
Total CO\(_2\) emission reduction over life of vehicle
(including during manufacture)

\(\Delta\) 50 tons

\(\Delta\) 5 tons CO\(_2\) reduction/(CF 1 ton-year)

\(\Delta\) 0.5 tons CO\(_2\) reduction/(unit-year)
### CO₂ reduction by vehicle weight

<table>
<thead>
<tr>
<th>Weight (Kg)</th>
<th>Automobile Rank</th>
<th>Number of Cars (Japan)</th>
<th>CO₂ reduction volume (ton/(unit-yr))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1750~</td>
<td>Luxury sedan, Minivan</td>
<td>approx. 4 million units</td>
<td>0.86</td>
</tr>
<tr>
<td>1500~1750</td>
<td>Middle class sedan</td>
<td>approx. 8 million units</td>
<td>0.69</td>
</tr>
<tr>
<td>1000~1500</td>
<td>Popular car</td>
<td>approx. 24 million units</td>
<td>0.42</td>
</tr>
<tr>
<td>~1000</td>
<td>Compact car</td>
<td>approx. 6 million units</td>
<td>0.35</td>
</tr>
</tbody>
</table>

CFRP in use by 17% to cars weighing over 1,500 kg with large CO₂ reduction effect (30% light in weight)

9 million tons of CO₂ per year can be reduced (equivalent to about 3.5% of total CO₂ emissions derived from Japanese transportation sector)
EcoChallenge

[New Energy] Initiatives to Develop Technologies Related to New Energy

- Lithium-ion battery
- Fuel cell
- Molten-salt type Solar cell
- Wind power
- Water power
- Thermal power
- Nuclear power

- Small
- Scale
- Large

- Direct Methanol type (DMFC)
- Poly-electrolyte type (PEFC)
- Electric double layer capacitor
- Nickel Hydrogen Battery, etc.
- High-performance separator
- Films for back sheet
- CFRP blades
- CFRP uranium centrifuge
- PPS fiber bag filter
- Hydrocarbon electrolyte membrane
- C/C paper electrode substrate

- Facilities
- Housing
- Cars
- Mobile (PC/phones)
- Personal
- Public

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Toray promotes developments and commercialization of nonfood biomass-origin materials through the integration of biotechnology and nano-technology.
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The Automobile Industry in a Great Revolutionary Era

2010 and onward: gasoline internal-combustion engines will shift to electrical systems which will urge “weight-saving” issues

Internal-combustion engines

HEV

Plug-in hybrid vehicles

Electric vehicles

Fuel-cell electric vehicles

2030

Establishment of LiB technology

Upgrading of charging infrastructure

Upgrading of system control

Next-generation secondary battery

Innovative secondary battery

Hydrogen-storage technology

Upgrading of hydrogen infrastructure

Innovative hydrogen production technology

Efficiency improvement of motors

Upgrading of system control

High-tensional steel

Aluminum

Magnesium

Carbon fiber composite materials (thermosetting) → (thermoplastic)

Weight saving of automobiles

Changes in powertrain

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One of Toray’s main plant with many automobile and aircraft manufacturers located within 100km area.
Concept for Nagoya Plant A&A Center

Concentrate Toray’s comprehensive ability in the Nagoya area and establish a new development base for technological development through close ties with the automobile and aircraft industries.

A&A Center (Development center for Automobiles & Aircraft)

Plastics Application Technology Development Center
[Opened in 1989]

[Automobile and E&E Application]
- Development of engineering plastics
- Development of molding technologies for engineering plastics

Automotive Center
[Opened in 2008]

[Automobile Application]
- Offering solutions, project management (collaboration with outside companies and inside department, integration of advanced materials technologies of Toray Group)
- Development of automobile-related elemental technologies (evaluation and analysis)

Advanced Composite Center
[Scheduled to open in 2009]

[Automobile and Aircraft Application]
- Development of composite materials
- Development of composite molding technology

The 3 Centers cooperate and supplement each other to conduct technology development

Collaboration

Research laboratory, Development center, each technical department (resins, chemicals, films, electronic & information materials, affiliated companies, etc.)
Targets for the Establishment of Automotive Center

Joint development from conceptional stage

Customers

Search of specs
Collaborative design/
Consideration of materials and parts
Evaluation of parts and modules

Automotive Center

Technology integration

Advanced materials technology

Advanced processing technology
Product design support

Toray Group

Realization of innovative automobiles / future car

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Outline of Transfer of Composite Development Functions

Synergy effect and speed-up of development attributable to the consolidation/reinforcement of composite development functions.

Existing composites development bases

Shiga Plant
Composites Technical Department

Ehime Plant
Composites Technical Department
Composites Development Center

Consolidate/reinforce composite development functions which are scattered in Shiga and Ehime

Future composites development base

Nagoya Plant
Advanced Composite Center (ACC)

(1) Automobiles
① Thermal cure high-speed RTM technology
② Filament-winding molding technology
(2) Aircraft
① Prepreg molding technology
② A-VaRTM technology

Head Office: Strategy development, technical support

Concentrate comprehensive capability of development
Strengthen development functions through the improvement of experimental/evaluation facilities
Integration of Toray Group resins and chemicals technologies
Strengthen collaboration with vital customers in the Chukyo district
Outline of Transfer of Composite Development Functions

In the automobiles and aircraft area, Toray will add advanced design/process technologies of the Advanced Composite Center to the innovative technologies created through co-development with customers or national projects, and apply them to production.

Advanced technologies of Advanced Composite Center

<table>
<thead>
<tr>
<th>Materials/Evaluation technology</th>
<th>Design/Analysis technology</th>
<th>Molding technology</th>
<th>Process technology</th>
</tr>
</thead>
</table>

Co-development / National project

*(High-speed RTM, A-VaRTM materials, etc.)*
Structural Reform of Nagoya Plant

Production/development base of chemicals/resins

Production

Early years
- Started production of caprolactam as Japan’s first plant of raw materials for the production of Nylon (1951)
- Started production of nylon resins (1956)
- Started production of fine chemicals (1980)

R&D
Chemicals Research Laboratories

Plastics Application Technology Development Center
Composites Development Center
Composites Technical Department
Transfer from Shiga/Ehime Plants

A&A Center
Plastics Application Technology Development Center
Automotive Center (2008~)
Advanced Composite Center (2009~)

Transfer from Ehime Plant Business expansion
Consolidate to Ehime Plant High-value creation
Shift to high-performance products
Promote development of integrated technologies
Consolidate to Tokai Plant High-value creation

High-performance Chemicals

2003 2007 2015

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Expansion Plan for Toray Automotive Business

Net Sales (Billion yen)

- New Items
- Electronic & Information Materials, etc.
- Advanced composite materials
- Resins
- Fibers & Textiles

Actual

Plan

2005 2006 2007 2008 2010 2015

200 350

103.0 124.0 139.0 150.0

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The Automotive Center

Toray Industries, Inc.
General Manager
Automotive Center
Yasuo Suga
Function of Each Organization of A&A Center

**A&A Center**
- Development site for automobile and aircraft application

**Plastics Application Technology Development Center**
- (Automobile and E&E application)
- Development of engineering plastics
- Development of molding technologies for engineering plastics

**Automotive Center**
- (Automobile Application)
  - Offering solutions
  - Project management
  - Development of composite materials and processing technologies
  (collaboration with outside companies and inside departments, integration of advanced materials technologies of Toray Group)
  - Elemental technologies (evaluation and analysis)

**Advanced Composite Center**
- (Automobile and Aircraft application)
  - Development of composite materials and composite products
  - Development of composite processing technologies

<table>
<thead>
<tr>
<th>Name</th>
<th>Plastics Application Technology Development Center</th>
<th>Automotive Center</th>
<th>Advanced Composite Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main equipments and facilities</td>
<td>(Materials) Molding equipments Material evaluation facilities</td>
<td>(Parts ~ Modules) Large molding/processing equipments Facilities for dynamic evaluation of parts</td>
<td>(Materials ~ Parts) CF base materials processing equipments Large press/ RTM molding equipments</td>
</tr>
<tr>
<td>Open</td>
<td>October, 1989</td>
<td>October, 2008</td>
<td>April, 2009 (scheduled)</td>
</tr>
</tbody>
</table>

The 3 Centers cooperate and supplement each other to conduct technology development
(Numbers of staff (plan): Total 250 members at 3 centers)

Collaboration
- Research laboratories, Development centers, Each technical depts., Affiliated companies
Operation Concept and Function of Automotive Center

- Participation from the customer’s planning and conceptional stages for joint development toward shared targets.
- Offering solutions that fuse together Toray’s materials, technologies and services.

Three major functions of Automotive Center:

**Joint development**
Management of joint projects with customers.

**Technology Development**
Development of automotive polymer material evaluation, analysis, molding and processing technologies.

**Information transmission**
Acquisition and transmission of fresh automotive technology news, organization of technical seminars.

Materials, Technologies and Services of Toray
- Advanced Composite Center
- Plastics Application Technology Development Center
- Laboratories (fiber, composite, films, etc.)
- Development Centers
- Each Technical Dept.
- Subsidiaries and Affiliated Companies (TRC, Toray Techno, TDC, etc.)
- Universities, Research Institutions
- Partner Companies (molding device manufacturers, molding companies, etc.)
Characteristics of the Automotive Center

- Conventional development style
  Materials manufacturers specialize in material developments (spec-in business)

---

Automobile Manufacturers  
Auto Parts Manufacturers

Modules/Compartments Development

Parts Development

Materials Development

Laboratories  
Development centers  
Technical dept.  
Subsidiaries and affiliated companies

Toray Group
Development style in Automotive Center
Coordination and integration of various technology resources of Toray Group
Joint developments of parts and units with customers through evaluation and analysis technologies as Parts.

- Modules/Compartment Development
- Parts Development
- Materials Development

Automotive Manufacturers
Parts Manufacturers

Automotive Center

Laboratories
Development centers
Technical depts.
Subsidiaries and affiliated companies

Toray Group
Main Issues (Four Major Themes) of Automotive Center and Toray’s Strength

**Theme 1. Weight Saving**
Target parts: Panels, Main structural parts (chassis), etc.
Toray’s strength: CFR thermoplastic, Film decorating, CAE technology.

**Theme 2. Materials for Next Generation Power Train**
Target parts: Motor, Secondary battery, etc.
Toray’s Strength: High thermal stability films, Functional nano particles.

**Theme 3. Non-petrochemical materials**
Targets parts: Fibers and textiles for interior and exterior parts
Toray’s strength: Bio-based plastics, its fibers and films, etc.

**Theme 4. Car Electronics**
Target parts: Display, Sensor parts, etc.
Toray’s strength: PDP, Polyimide resins, etc.
Application of Carbon Fiber Reinforced Plastics (CFRP) to Automobiles

CFRP = Carbon Fiber Reinforced Plastic

**Improvements using CFRP parts**

- **Weight Saving**
  - Improvement of fuel efficiency
  - Global warming countermeasure
- **Improvement of crash safety**
  - (High Impact energy absorption)
- **Improvement of driving performance**
  - Improvement of vibration damping / natural frequency UP
- **Reduction of Assembly processes and cost**
  - Modular Construction

**CFRP Applications and its effect on weight saving**

- **Red: Toray's achievement**
  - Roof (-10kg)
  - Trunk lid (-5kg)
  - Rear spoiler (-4kg)
  - Impact beam (-3kg)
  - Hood (-12kg)
  - Defuser (-10kg)
  - Drive shaft (-5kg)
  - Platform (-150kg)

**Possible to reduce 400kg using CFRP parts (30% of car body weight)**

- Others (-200kg)
  - Door panel
  - Front end module
  - Seat back
  - Fender, etc.

**Improvements using CFRP parts**

- **Improvement of crash safety**
- **Improvement of driving performance**
- **Reduction of Assembly processes and cost**

When the car weighs 1,380 kg
Examination of applicable parts of CFRP
(Thermoset resin base and thermoplastic base)

Average weight of conventional car: 1,380kg

CFRP (Thermoset resin) (RTM molding)
Panels, Structural parts (30% the weight of steel)

CFRP (Thermoplastic) (Injection / Press molding)
Interiors, 2nd structural parts, Electronic parts
(50% the weight of steel)

Weight of car with CFRP: 970kg (▲30%)

New CFRP (thermoplastic) for high performance parts (complicated shapes), common parts (mass productivity) will be performed
Facilities to Solve Technical Issues of CFRP (Thermoplastic)

1. Improvement of material reliability (Dynamic properties and Durability)
   ① Impact resistance - scattering stone, car crash, pedestrian protection

   - Charpy impactor
   - Weight-drop impactor
   - Head impact facilities

② Durability, weather resistance - hygrothermal resistance, long-term outdoor exposure, thermal shock, etc.

   - Large constant temperature and humidity chamber
   - Xenon weather meter
   - Large thermal shock chamber
Evaluation of Impact Resistance

1. Impact resistance

- Various impact evaluation facilities for testing specimens and automotive parts (To construct databases for impact resistance and failure behavior of plastic materials)
- Estimation of impact strength and failure behavior as car parts with combination of CAE technologies to reduce time and labor.

Observation of failure mechanism

Charpy impactor

10 × 60 mm

Weight-drop impactor

80 × 80 mm

Nondestructive evaluation

Test facilities for pedestrian protection

Large parts

2,000 × 2,000 mm

Charpy test (shot by high speed camera)

transfer function:

\[ a = f(t) \]

To confirm compatibility of analysis with examination
Evaluation of Durability

② Weather resistance / Long-term durability

- Confirms material reliability of new polymer materials for car parts

Evaluation facilities for test specimens

- Long-term weather resistance (ultraviolet degradation)
- Long-term light resistance
- Long-term heat stability
- Absolute dry properties

Evaluation facilities for large scale parts

- Long-term hygrothermal stability
- Water absorbed properties
- Thermal shock properties
- High / low temperature aging properties

Xenon weather meter

Perfect oven

Large constant temperature and humidity chamber

Thermal shock chamber
Improvement of Surface Quality (painting and film decorating)

2. Improvement of surface quality
   ① Painting performance – coated properties, coating strength, improvement of surface quality

   Robotic painting equipment
   Digital gonio photometer
   Surface roughness meter

   ② Film decorating technology – development of new plastics / films materials

   Film laminating machine
   Vacuum molding machine
   1000t injection molding machine
Improvement of Surface Quality (painting)

1. Painting performance – coated properties, coating strength, surface quality

- Development of suitable materials for various paints and painting processes and optimization of painting conditions

Paint booth (outline)

- Main specification:
  - maximum painting area: 1700×1700 mm
  - maximum drying temperature: 140 °C

Painting quality evaluation

Painting durability evaluation

Painting robots

Entrance

Exit

Painting robot

Drying oven

Larger thermal shock chamber

Large constant temperature and humidity chamber

Digital Gonio photometer (AMC)

Surface roughness meter

(Plastics Application Technology Development Center.)

Variable Gloss Meter

(Plastics Application Technology Development Center.)
# Improvement of Surface Quality
(film decorating)

② Film decorating technology (high quality / designing surface, paint-less)

- Offering new surface appearance and design which is suitable for polymer materials

<table>
<thead>
<tr>
<th>Film processing</th>
<th>Film insert molding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimming</td>
<td>Preforming</td>
</tr>
<tr>
<td>Printing</td>
<td>Insert molding</td>
</tr>
<tr>
<td>Laminating</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

### Film processing
- Trimmer
  - Maximum process width: 600 mm
- Semiautomated serigraph
- Film laminating machine
  - Maximum printing area: 600×600 mm
  - Maximum process width: 600 mm

### Film insert molding
- Vacuum molding machine
- 1000 ton injection molding machine

### Evaluation
- Film adhesive strength
- Surface roughness, brilliance
- Heat stability, durability (long-term / short-term)
Evaluation and Analysis System of Automotive Center and Toray Group

Customers

Realization of various supports through utilization of technological resources in Toray Group

Automotive Center (Automobile Application)
- Evaluation and analysis of automotive parts

Advanced Composite Center (Automobile and Aircraft Application)
- Evaluation and Analysis of CFRP composites
- Aircraft inspection technology

A&A Center
- Plastics Application Technology Development Center (Automobile and E&E Application)
  - Evaluation and analysis of plastics

Automotive Center
- Evaluation and analysis of automotive parts

Laboratories and Technical depts.
- Evaluation and analysis of particular fields

Toray Research Center
- Advanced evaluation, analysis

Toray Techno Environmental evaluation analysis

Toray Engineering
- CAE analysis, evaluation, etc.
Application of Aircraft Inspection Technologies

- Application of inspection technologies for aircraft materials
- Estimation of strength and lifetime of parts by Nondestructive.

**Ultrasonic C-scan**
Observation of defects within the material and measurement of damage level

**3D X-ray scanner**
Observation and measurement of orientation angle and distribution of fibers

Ex. Relation between CFRP internal defect and strength

Specific fracture pattern of composite material

Large defects on invisible defect

- The other inspection and analysis facilities in Toray group

- Hydraulic fatigue machine (AMC)
- Creep machine (AMC)
- High speed impact machine (Plastics Application Technology Development Center)
- DSC/DMA (Plastics Application Technology Development Center)
- 3D shape measurement equipment (ACC)

Application of aircraft development technologies in automobile fields
Battery and Electrode Evaluation and Analysis Technology (Toray Research Center)

- Estimation and Improvement of performance of battery and electrode by shape observation, composition and structural analysis

Lithium-ion battery

- Morphological analysis, composition and structural analysis of positive/negative-electrode materials
- Thickness and composition analysis of electrode membranes (SEI membranes)
- Composition analysis and additives and trace impurities analysis of battery electrolytes, etc.

TEM observation of LiCoO$_2$ positive electrode after repeated charge and discharge cycles

- Cracks occurred on the positive electrode materials by deterioration of long-term usage. On the surface of positive electrode particles, Co changed to the conditions like metal

Fuel cell

- Structural analysis and property evaluation of electrolyte membranes
- Structural and composition analysis of catalyst particles
- Composition analysis and trace impurities analysis of battery electrolyte, etc.

Observation of supported condition of a catalyst particle by 3D TEM

- Particle size and supported condition of nm size catalyst particles can be observed in three dimensions.

Realization of high capacity, Improvement of cycle properties, and Improvement of safety

Solution of deterioration mechanism (Improvement of durability)
Reduction of Pt usage (Cost reduction)
Toray has started R&D of CAE technology since 1970s and has developed several fields of CAE technologies for polymer materials.

Toray has started design support for customers using CAE analysis since 1980s. (total 4,000 cases)

Based on combination of CAE analysis and various test evaluation technologies and databases, performance and quality of end products can be estimated.

### CAE Technology for Automobile Application

**Structural Analysis**
- 1980
  - Layer stack
  - Anisotropy
- 1990
  - Nonlinear
  - Contact
  - Creep
  - Adhesion
- 2000
  - Pedestrian protection
  - Assembly

**Vibration Analysis**
- 1980
  - eigenvalue
  - frequency response
- 1990
  - Penetrating sound
  - Radiated sound
- 2000
  - Assembly

**Fluid Analysis**
- 1980
  - Viscosity
  - Flow/Structural couple
- 1990
  - Multilayer
  - Viscoelasticity

### CF Composite field
Design support for customers’ end products
- 50 cases / year, total sum over 500 cases (1990 ~)

### Plastic field
Design support for customers’ end products
- 250 cases / year, total sum over 3,600 cases (1980 ~)

### Software Businesses (TEK)
Injection Molding CAE “3D TIMON”
Total sum of sales 250 companies, 450 sets (1980 ~)

### Item
<table>
<thead>
<tr>
<th>Item</th>
<th>Plastics</th>
<th>Composites</th>
<th>Films</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Injection field</strong></td>
<td>Injection Molding Analysis (flow, warpage)</td>
<td>RTM Molding Analysis (Resin flow)</td>
<td>Vacuum Molding Analysis (film setup)</td>
</tr>
<tr>
<td></td>
<td>“3D TIMON”</td>
<td>“VAR-TIMON”</td>
<td></td>
</tr>
<tr>
<td><strong>Analysis field</strong></td>
<td>Structural Analysis</td>
<td>Impact Analysis</td>
<td>Vibration Analysis</td>
</tr>
</tbody>
</table>
Support of design for customers’ product from an early development stage, cooperation of each dept., utilization of CAE technology → Design and Development time / Experimental evaluation cost can be reduced

Many achievements of co-development and design support for automobile manufactures and auto parts manufactures

CAE development and support system

Automotive Development Center
- CAE elemental technology development
- Customer design support

Advanced Composite Center
molding / design / evaluation analysis of composite materials

Plastics Application Technology Development Center
molding / design / evaluation analysis of plastics

Toray Engineering Co., Ltd.
Development and sales of injection molding CAE software “3D TIMON”

Main CAE application parts

Hood
Front end module
Engine cover
Intake manifold
Cylinder head cover

Roof
Trunk lid
Rear spoiler

Fender

Power module
Shift lever base

Instrument panel

Pillar reinforcement body

Connector

ECU case

Fuel tank

Connector

ECU case

Fuel tank
Automotive Center’s Function of Collection and Transmission of Information

- Introduction of timely Toray Group’s advanced materials and technologies (molding, processing, evaluation, analysis, etc.)
- Collection of new information from customers, universities, companies.

Toray Group’s Advanced Materials and Technologies

- New material nano-alloy
  - Nano controlled new materials
- Analysis
  - Property evaluation and analysis technology
- Simulation
  - Proposal of analysis method of new materials
- Information Collection
  - Academic information
  - Market information
  - Innovative technology
- Molding
  - New molding technologies of new materials
- Process
  - 5mm
- Information Transmission
  - Technology seminar
  - New technology display
  - Library display
- Customers
- Partner Companies
- Universities, National laboratories

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Automotive Center’s Function of Collection and Transmission of Information ~ DB Library, IT ~

- Collection of measurements of evaluation / molding machines online and Construction of databases
- Establishment of the library which selected / combined / integrated multiple data → Promptly search and offer materials data which meet customers’ and internal relevant departments.

Evaluation facilities
- Database
- Library
- Collection of measurements of evaluation / molding machines online and Construction of databases
- Establishment of the library which selected / combined / integrated multiple data → Promptly search and offer materials data which meet customers’ and internal relevant departments.

Intranet System
- Measurement / Analysis Data
- Common Server
- Various Data
- Database Library

Injection Machine
- Draft, Document, CAE
- Molding Condition Data

Draft, Document, CAE
- Draft, CAE data

Intranet
- Web Server
- Security Gate

Customer Co-developer
- Involved departments Subsidiaries and affiliated companies

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Outline of Automotive Center’s Facilities

<Gallery, Conference Room>

**Main Building 1F (Display Lobby)**
- Themes Display Area
- Materials Display Area
- Entrance
- New Technology Display Area

**Main Building 2F (Conference Room, Seminar Room)**
- TV Conference Room (30 people capacity)
- Seminar Room (80 people capacity)
- CAE room
- Others
  - 2 small conference rooms with 15 people capacity
  - 1 medium conference room with 30 people capacity
  - 1 reception and conference room with 10 people capacity
Advanced Composite Center
Development Functions of Advanced Composite Center

- **Design / Analysis**
  - Early involvement with customer
  - CAE (Vibration / damping etc.)

- **Material Development**
  - New CFRTP

- **Machining / Inspection**
  - Automated process technology
  - Continuous trial process of Molding / Machining
  - Industrial clusters

- **Molding technology**
  - Ultimate pursuit of molding tech.
  - Creation of innovative molding tech.

**Equipment**
- Equipment of Water jet, and Fatigue test, etc.
- Equipment of RTM, A-VaRTM, Hot press and Pultrusion, etc.

**Molding Technology**
- Ultimate pursuit of molding tech.
  - Creation of innovative molding tech.
- Industrial clusters
  - Technological collaboration

**Basic strategies**
- Collaborate

**Major Growing Business Fields**
1. Development of new applications
2. Creation of high value-added products

**Collaboration**
- Toray Group
- manufacture
- Industrial cluster

**Advanced Composite Center**

**Automotive Center**

**Automotives**

**Aircrafts**

**Information Technology devices**

**Industrial Mechanical parts**

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### Major Development Functions of Advanced Composite Center

- **Acceleration of innovative technologies creation and mass-production technologies establishment by reinforcing molding / evaluation equipments.**

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Major equipments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Material development / Evaluation</td>
<td>Mechanical property test, Fatigue test DMA</td>
</tr>
<tr>
<td>2. Design technology</td>
<td>CAD, CAE</td>
</tr>
<tr>
<td>3. Molding technology</td>
<td>RTM, Autoclave, Injection molding</td>
</tr>
<tr>
<td>4. Machining / Inspection technology</td>
<td>Water jet, 3-dimension measurement</td>
</tr>
</tbody>
</table>

**Automotives**: Establishment of continuous development / trial-production system for materials, design, molding and machining

1. Creation of design/molding/machining technologies: To develop new applications and expand composite materials business
2. Creation of new materials and deepen molding technologies: To expand materials business and enhance technical support functions
<table>
<thead>
<tr>
<th>Area</th>
<th>Major applications (Now going)</th>
<th>Expansion and New Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-related</td>
<td>• Fuel cell (electrode gas diffusion layer)</td>
<td>• Fuel cell</td>
</tr>
<tr>
<td></td>
<td>• Wind turbine (small wind-turbine blades)</td>
<td>(electrode gas diffusion layer)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• High-pressure vessel</td>
</tr>
<tr>
<td>Fuel cell stack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport machinery</td>
<td>• Automotive propeller shaft</td>
<td>• Automobile propeller shaft/Exterior panels</td>
</tr>
<tr>
<td></td>
<td>• Exterior panels (sports car)</td>
<td>• Automotive structures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Aircraft structures</td>
</tr>
<tr>
<td>Civil engineering and Construction</td>
<td>• Bridge railings</td>
<td>• Bridge railings</td>
</tr>
<tr>
<td></td>
<td>• Seismic retrofitting (bridge pier, deck slabs, buildings (beams, columns))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lightweight building structures (truss, roof structures)</td>
<td></td>
</tr>
<tr>
<td>Industrial equipments</td>
<td>• Medical equipments (X-ray equipment)</td>
<td>• Information technology device (Laptop PC case)</td>
</tr>
<tr>
<td></td>
<td>• Information technology devices (Laptop PC case, etc.)</td>
<td>• industrial robot</td>
</tr>
<tr>
<td></td>
<td>• Mechanical parts (Robot arms for LCD panel, etc.)</td>
<td></td>
</tr>
</tbody>
</table>
Expansion Strategy of Automotive Materials Business

Toray Industries, Inc.
Senior Director
Automotive Material Strategic Planning Dept.
Kazumichi Ebisutani
Contents

• Toray Group’s Involvement in the Automobile Industry
• Environment and Issues surrounding the Automobile Industry
• Expansion Strategy of Automotive Business
Contents

• Toray Group’s Involvement in the Automobile Industry

• Environment and Issues surrounding the Automobile Industry

• Expansion Strategy of Automotive Business
~ Toray Group’s Involvement in the Automobile Industry ~
Toray Group’s main materials and technologies for Automobiles

【Fibers and Textiles】
Fiber and fabric for airbags, tire cord, fabric and man-made suede for car seats, cabin filter, etc.

【Resins & Chemicals】
Resins for automotive parts (ABS, Nylon, PBT, PPS, LCP)
Polyolefin foam for interior and exterior

【Carbon Fiber Composite Materials】
Hood, Roof, Propeller shaft, Spoiler, Impact beam, etc.

【Films】
Films for capacitor, motor insulation and decorating and process films

【Electronic & Information】
LCD color filter, Optical fiber, Polyimide film for FPC

【Technical Support for Customers’ Design, Processing Technologies/Facilities】
Toray Research Center Inc. (analytical evaluation technologies), Toray Engineering Co., Ltd. (process technology and CAE analysis), etc.
~ Toray Group’s Involvement in the Automobile Industry ~

Toray Group’s Sales for Automobiles

(Billion Yen)

<table>
<thead>
<tr>
<th></th>
<th>FY2005</th>
<th>FY2006</th>
<th>FY2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others (Films, Electronic materials, Chemicals)</td>
<td>103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Fiber Composite Materials</td>
<td></td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>Plastics</td>
<td></td>
<td></td>
<td>139</td>
</tr>
<tr>
<td>Fibers &amp; Textiles</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Contents

• Toray Group’s Involvement in the Automobile Industry

• Environment and Issues surrounding the Automobile Industry

• Expansion Strategy of Automotive Business
Population expansion in developing countries

Low cost workforce

Economic development of BRICs
Mass consumption
Mass production
Improvement of quality of life

Mass consumption
Mass production
Improvement of quality of life

Skyrocketing Oil price

Population expansion in developing countries

Low cost workforce

Environmental issue
Global warming
CO2 reduction

Energy issue
Resource depletion
Alternative energy

Skyrocketing Oil price

Population expansion in developing countries

Low cost workforce

Japan & Europe

Aging of the population
Workforce decreasing
Low birthrate
Pursuit of safety

Advanced information
Advancement of IT technologies

Advanced road information system
Sensor / ECU

Information / Electronics

Safety / Comfort

Creation of new added value

Slump of Big3
Quality improvement
Rise of small cars

Advanced information
Advancement of IT technologies

Biofuel
Electrical energy
Hydrogen energy etc.

Hybrid car
EV
fuel-cell
vehicle etc.

North America

Emerging Country

~ Environment and Issues surrounding the Automobile Industry ~

Market Changes in the Automobile Industry

Semiconductor
High definition Display
Large-volume information system
Electronic control, etc.
Regardless of downturn in world economy, the number of global automobile productions tend to increase due to the rise of BRICs and the economic growth of developing countries.
~ Environment and Issues surrounding the Automobile Industry ~

Revolutionary Era of the Automobile Industry

**Environment / Energy**
- CO2 reduction
- Alternative energy, etc.

**Safety / Comfort**
- Pre-crash safety system
- Relax / comfort, etc.

**Information / Electronics**
- Advanced road information system
- Electronic control / sensor, etc.

**Weight saving**

**Next generation power train**

**Non-petrochemical-based materials**

**Car electronics**

**Revolutionary era for systems**
- HEV/PHV/EV/FCV, etc.

**Increase of electronic devices**
- Semiconductor / ECU, etc.

**Revolutionary era for materials**
- Carbon fiber / Plastics, etc.

Toray contributes to the automobile industry by advanced materials and technologies
Contents

• Toray Group’s Involvement in the Automobile Industry
• Environment and Issues surrounding the Automobile Industry
• Expansion Strategy of Automotive Business
Main Items for Expansion of Automotive Business

Issues of the automobile industry:

- Safety / Comfort
- Environment / Energy
- Information / Electronics

Integration of materials:
Integration of materials such as fibers, plastics, films, carbon fiber composite materials, etc.

Organic Synthetic Chemistry

Polymer Chemistry

Nanotechnology

Biochemistry

Advanced Materials / technologies:
Nanotechnology-based innovative materials, Low environmental load materials, Innovation materials of semiconductor / circuit, Next generation display, Nano control structure, Nano fabrication, New polymer materials, Green chemistry, etc.

Toray’s Innovation

Weight saving:
- Roof, Hood, Quasi-structure material, etc.

Next generation power train:
- Motor, Secondary battery, etc.

Non-petrochemical-based materials:
- Interior

Car electronics:
- Display, Electronic component, Sensor, Semiconductor, etc.
Trend of the automobile industry

Automobile manufactures established weight saving projects and consider expansion of application of light weight materials such as high-tension steel, aluminum, plastics, carbon fiber composite materials, etc.

Weight Saving Project of Automobile Manufacturers

<table>
<thead>
<tr>
<th>Project</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota</td>
<td>Weight ▲10% by 2011 (Midsize sedan)</td>
</tr>
<tr>
<td>Honda</td>
<td>Weight saving goals are not explicitly shown (CO2 ▲10% by 2010)</td>
</tr>
<tr>
<td>Nissan</td>
<td>Weight ▲15% by 2015 (Average weight)</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>Weight ▲30% by 2010</td>
</tr>
</tbody>
</table>

Toray’s strategy and corresponding materials and technologies

○ Advances development of high performance plastics with nano-alloy
○ Expands application of carbon fiber composite materials
○ Integrates plastics and carbon fiber composite materials

■ Exteriors such as fender (new nano-alloy plastics)
■ CFRP exterior body panel / structure (RTM/FW molding technology)
■ Impact-energy absorbing plastic parts (Impact-energy absorbing nano-alloy)
■ Quasi-structure materials (thermoplastic CFRP / New high rigidity Plastics)
~ Expansion Strategy of Automotive Business ~

Revolution of the Automotive Industry and Toray’s Response

- Advancement of Weight Saving
- Diversification of power trains
- Expansion of application of Nonpetroleum-based materials
- Car electronics

Trend of the automobile industry

- Automobile manufactures advance developments of several approaches such as clean diesel, alternative energy, HV, plug-in HV, electricity, fuel cell, etc.
- **HV core technologies such as power module, motor, secondary battery, etc. are applicable to all approaches.**

Toray’s strategy and corresponding materials and technologies

- Advances materials for HV/EV core parts such as motor, secondary battery, etc.
- Expands materials for fuel cells

- **Power module**  
  - Capacitor (PP film)
  - Case, Inverter (PPS resin)

- **Fuel cell**  
  - Hydrogen tank,
  - Electrode base material (Carbon fiber composite materials)

- **Secondary battery**  
  - Separator (heat resistance film)
  - Case, Plate (PPS resin)

- **Motor insulator**  
  - (PPS resin, PET/PPS film)

- **Common issues for cars**  
  - Weight saving (carbon fiber composite materials/plastics)
Trend of the automobile industry

- Toyota already adopted non-petrochemical-based materials for several parts.
- Other manufactures are also advancing the development of parts with non-petrochemical-based materials.

Toyota’s applications

- Spare tire cover
- Option mat

Toray’s strategy and corresponding materials and technologies

- Expand applications of interior and exterior parts with non-petrochemical-based fibers, plastics and films.
- Utilize advanced technologies such as nanotechnologies and new processing methods and advance improvement of properties, which is an issue to adopt non-petrochemical-based materials.

- Car seat surface (FY textured yarn)
- Head rest materials (SF lamination)
- Plastics for exterior/interior, decorating films (nano-alloy, plant fiber reinforced)
- Seat cushion material (SF lamination)
- Spare tire cover/trim (kenaf/PLA-SF board)
- Option mat (BCF+PLA nonwoven fabric)
~ Expansion Strategy of Automotive Business ~

Revolution of the Automotive Industry and Toray’s Response

- Advancement of Weight Saving
- Diversification of Power Trains
- Expansion of application of Nonpetroleum-based materials
- Car electronics

Trend of the automobile industry

○ Car electronics become diversified to advance comfort with car navigation, large-volume information system, etc. and to improve safety with ABS, brake assist, millimeter-wave radar, etc.
○ Car electronics corresponding to throttle control, engine control, HEV, EV, FCV advance.

Toray’s strategy and corresponding materials and technologies

Expand applications of advanced materials and technologies such as display, semiconductor materials, electronic circuit materials, high performance films, which have been cultivated in IT fields, into automobiles.

- LCD meter, In-car display such as car navigation, etc. (Color filter, Organic EL-related materials, etc.)
- Large-volume information system (Plastic optical fiber)
- Sensors, Semiconductors (High performance resin, Next generation resist, Semiconductor packaging circuit board, etc.)
~ Expansion Strategy of Automotive Business ~

Automotive Material Strategic Planning Dept.

Strategic Promotion Conference of Automotive Material
* Decision of sales expansion, planning and investment between divisions
* Total optimization and information unification
* Backup of each development theme

Representative window of Toray Group
Information gathering through direct contact with customers
Search of new development themes and needs
Proposal of solutions by Toray Group’s comprehensive ability

Obtainment of customers’ customer information and peripheral information

Automobile manufacturers / Auto parts manufacturers

Corporate Marketing Planning Dept. Corporate Strategic Planning Dept.
Fibers & Textiles Division
Resins & Chemicals Division
Films Division
Subsidiaries and Affiliated Companies of Toray Group
Technology Center
Electronics & Information Related Products Division
Torayca & Advanced Composites Division

routine work

Obtainment of customers’ customer information and peripheral information

routine work
Expansion Strategy of Automotive Business

Expansion Target of Automotive Materials Business

- Expand sales of materials which Toray currently holds by making them high performance and high added-value.

- Create new items which response to environment / energy, safety, comfort, car electronics with materials used in other applications, material integrations, advanced materials and technologies.

- Help the automobile industry contribute to global environment with advanced materials and technologies

(Billion Yen)
Descriptions of predicted business results, projections and business plans contained in this material are based on assumptions and forecasts regarding the future business environment, made at the present time. The material in this presentation is not a guarantee of the Company’s future business performance.