

# **Blue-LEDs innovating the world**

**: a case of industry-academia collaboration  
and current activities at Nagoya University**

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**Academia Research &  
Industry-Academia-Government Collaboration**

**Nagoya University**

# **Part 1**

## **Nobel Prized blue LEDs**

**As a case of industry-academia Collaboration**

# Blue LED was invented at Nagoya University

Nobel Prize in Physics 2014 awarded

Prof. **Akasaki, Amano** and Nakamura for blue LEDs



**Prof. Isamu Akasaki**



**Prof. Hiroshi Amano**



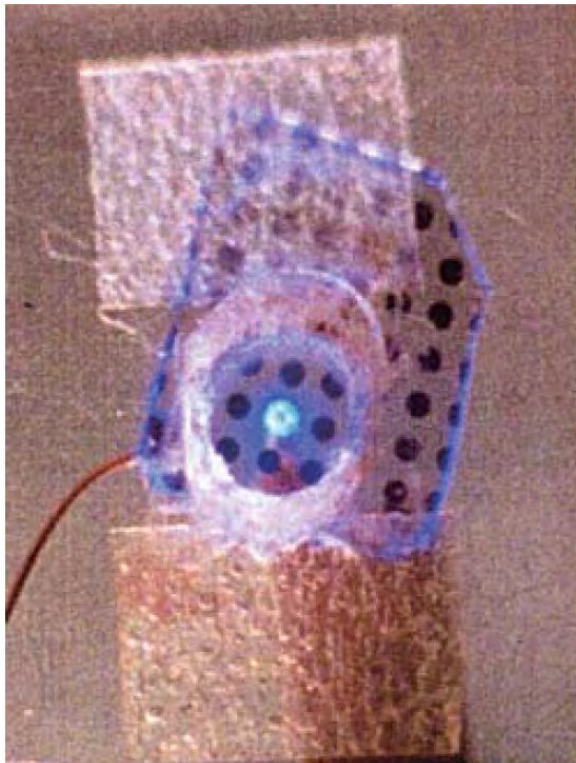
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# Blue LED was invented at Nagoya University

**Prof. Akasaki & Amano invented blue LEDs at Nagoya Univ.  
in collaboration with *Toyoda Gosei* corporation.**

豊田合成

**JST provided financial support to their research.**

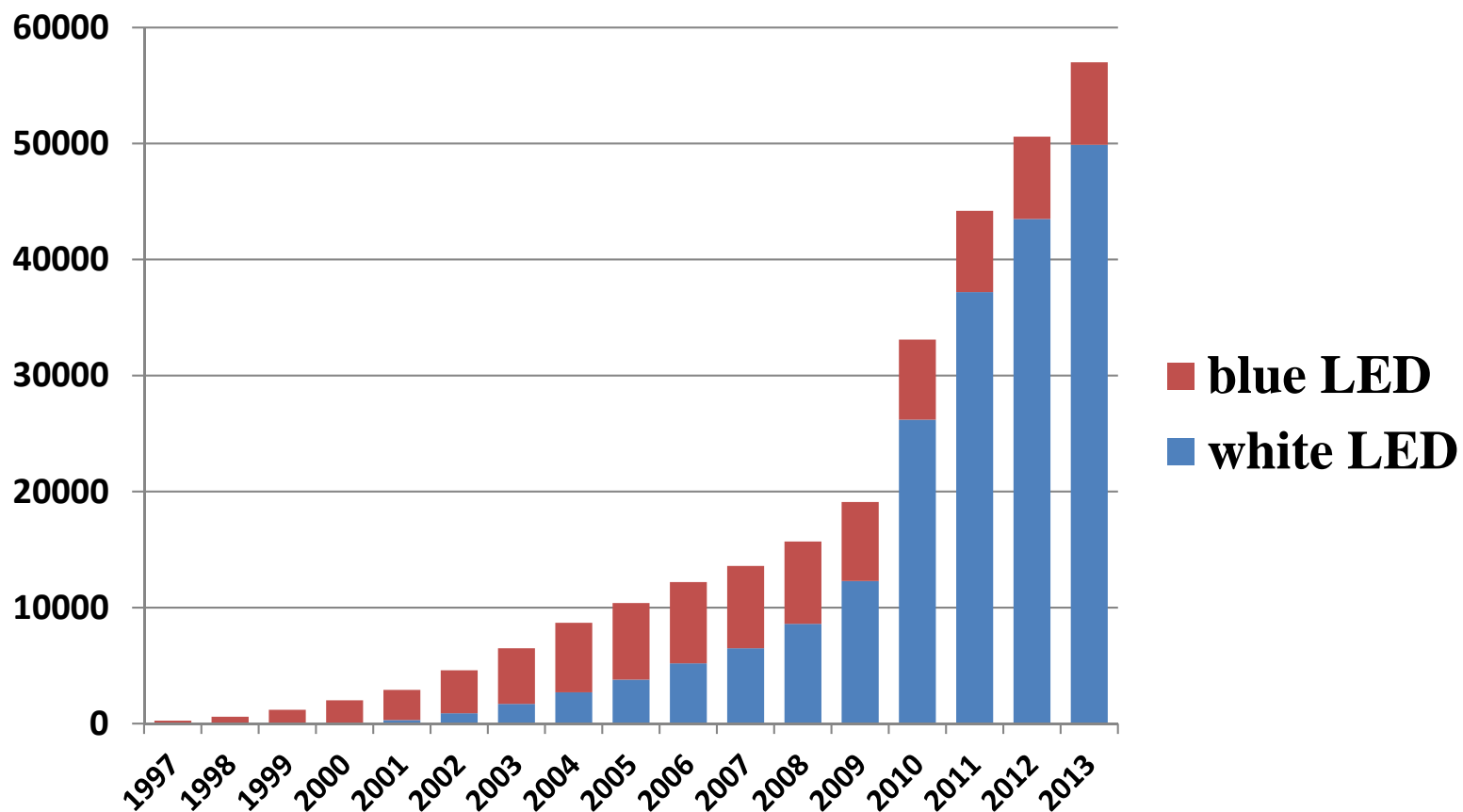


**The world's first p-n junction GaN blue LED  
(1989)**

# Market of blue and white LEDs is expanding

Market exceeded \$8,400M in the world

Million pieces



Made from the Report by Sogogiken

# Akasaki and Amano made two break-throughs

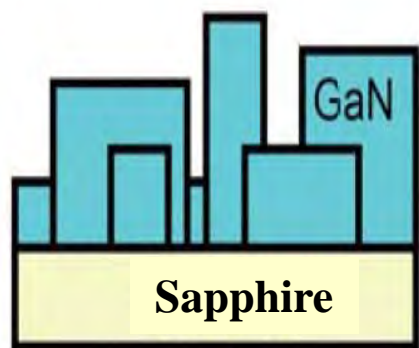
## 1. High quality GaN crystal

Prof. Akasaki and Amano succeeded in growing **high-quality GaN crystal**. Almost all people in the world did not believe it, before their success.

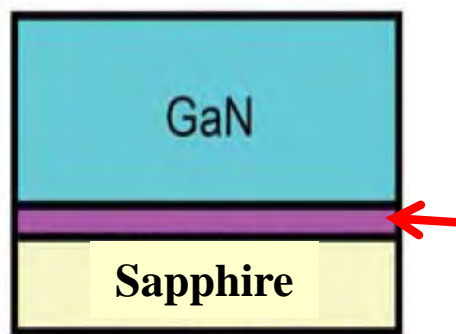
Based on the scientific theory of crystal, Prof. Akasaki foresaw

- it is possible to grow high-quality GaN crystal
- blue LEDs can be implemented only on GaN crystal

They invented **a low-temperature buffer layer** to grow GaN crystal on sapphire substrate in 1985 at Nagoya University

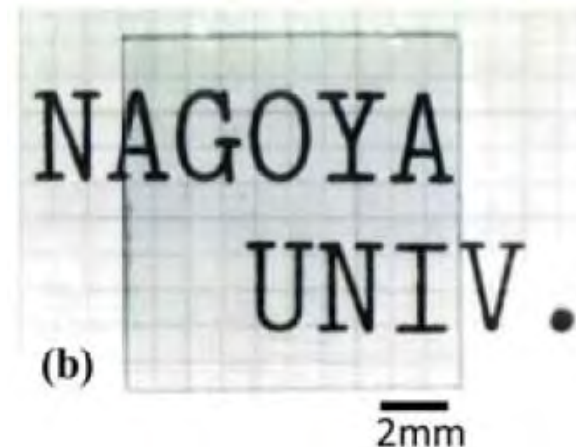


GaN directly on  
Sapphire substrate



GaN crystal  
on buffer layer

low-temperature  
buffer layer

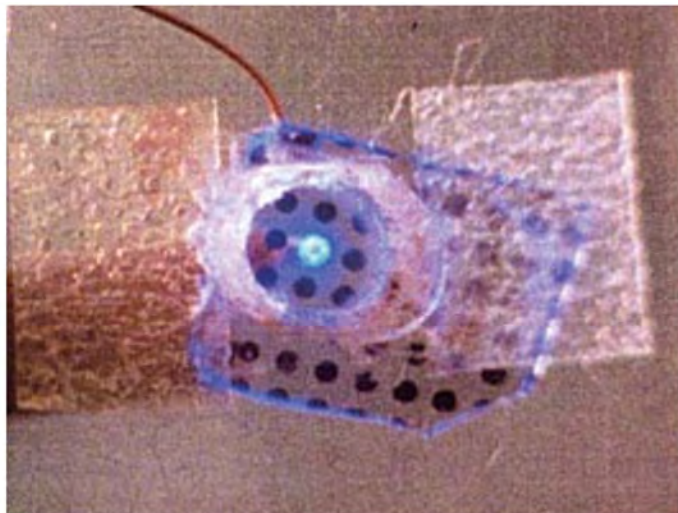


High-quality GaN crystal  
transparenting characters

# **Akasaki and Amano made two break-throughs 2**

## **2. p-n junction blue LED based on GaN**

**Even though they succeeded in growing GaN crystal, It was difficult to make p-n junction of GaN which was essential for LED. Prof. Akasaki and Amano invented the method to create p-type GaN and realized p-n junction of GaN, then practical blue LED was borne in 1989.**



**The world's first p-n junction GaN blue LED  
(1988)**

# Collaboration with Toyoda Gosei produced blue LEDs

## Successful example of industry-academia collaboration

- 1985 : Toyoda Gosei proposed a collaborative research with Akasaki group
- 1986-90 : collaborative research on crystal growth
- 1987-90 : JST funded the project of blue LED production technology
- 1989 : world's first p-n junction GaN blue LED
- 1991 : JST authorized succeed in development of blue LED
- 1995 : start mass production of blue LED



Experimental devise for  
GaN crystal growth in 1987



Meeting between Toyoda Gosei  
and Prof. Akasaki in 1987



# Collaboration with Toyoda Gosei



**Production line in Toyoda Gosei**



**Toyoda Gosei people congratulated Nobel Prize**

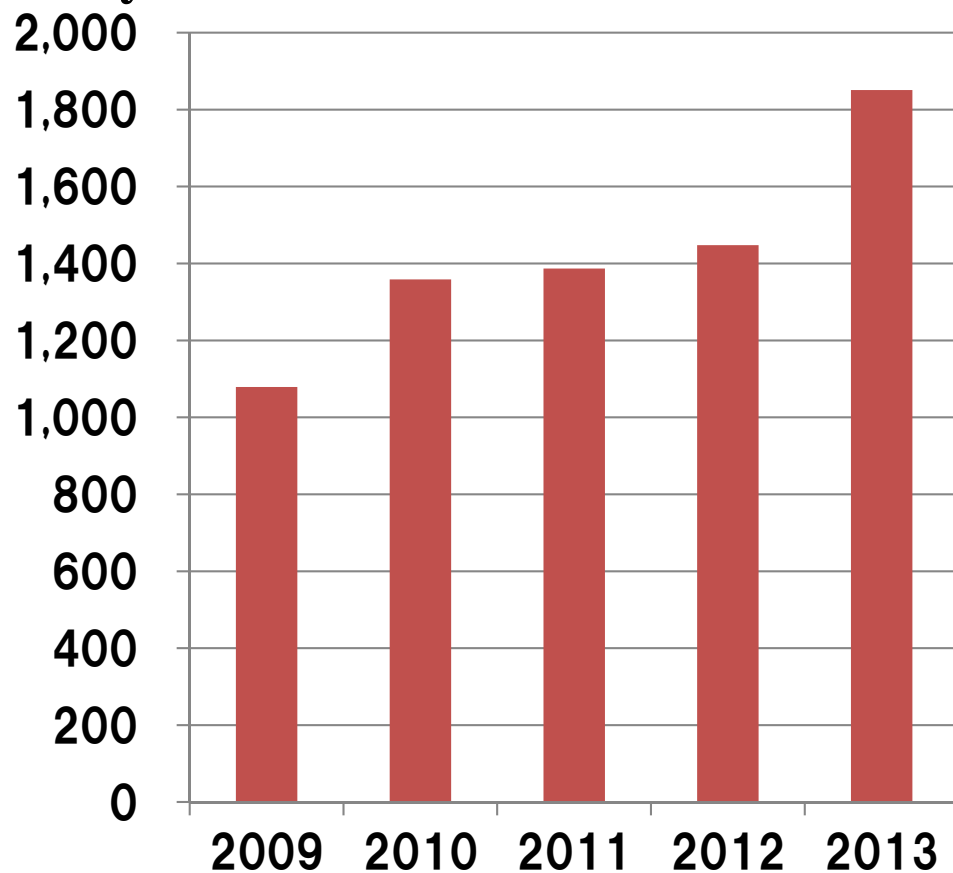
## **Part 2**

# **Current Activities of industry-academia collaborations at Nagoya University**

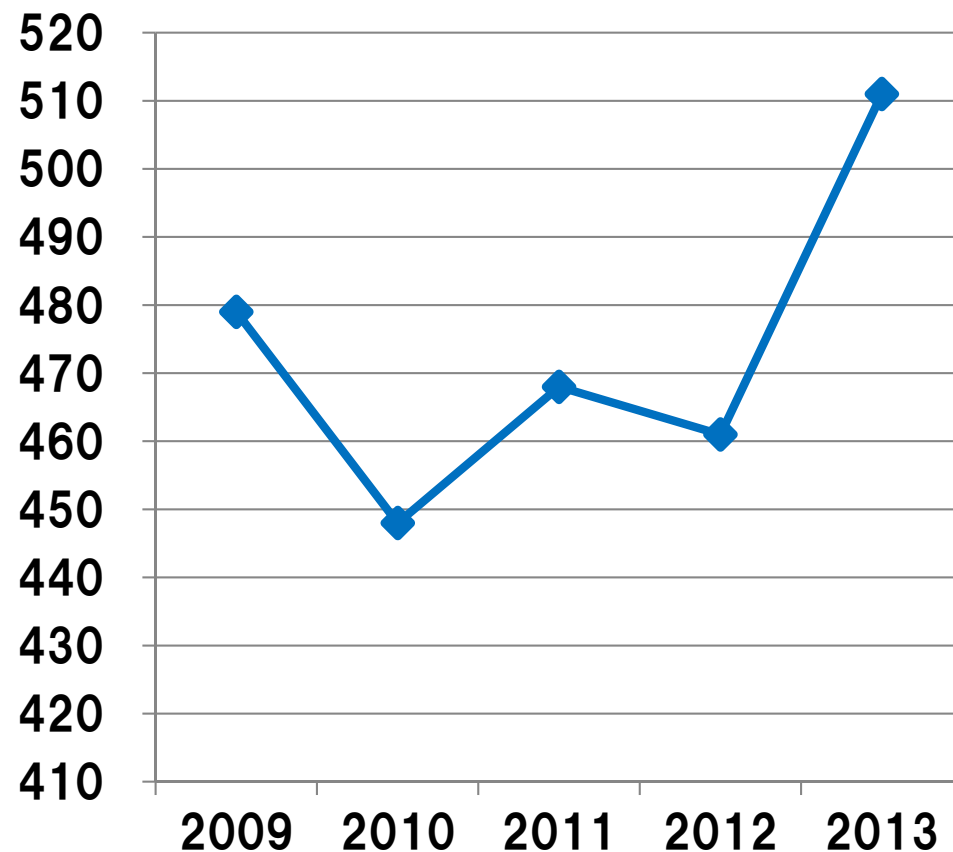
# Industry-academia collaboration at Nagoya University

## Budget from industry

Million yen



## Cases of collaboration research



# **Industry-academia joint programs at Nagoya Univ.**

## **Typical three programs**

- 1. Center Of Innovation program at Nagoya University**
- 2. National Composite Center**
- 3. Center for Embedded Computing Systems**

# The Center of Innovation (COI) Program in Japan

**The COI Program promotes challenging R&Ds to realize three visions for our ideal society. Twelve COI cites are supported by JST.**

## Three Visions of COI STREAM

### Vision 1

**Secure sustainability as a country advanced in its aging population and declining birth rate**

*Smart Life Care, Ageless Society*

### Vision 2

**Create a living environment with a high quality of life as a prosperous and reputable country**

*Smart Japan*

### Vision 3

**Establish a sustainable society with vitality**

*Active Sustainability*

**\*1) Ministry of Education, Culture, Sports, Science and Technology**

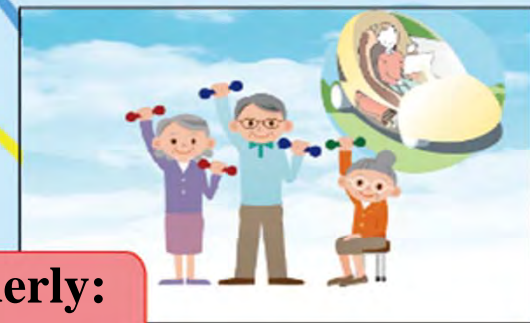
**\*2) Japan Science and Technology Agency**

# Goal of Nagoya COI : the “Mobility Society” for the Elderly

**Create services and activities which the elderly are willing to participate.**



**Construct transportation infrastructure, services and community to activate A lifestyle of the elderly.**



**The “Mobility Society” for the Elderly:  
Lead to an Active and Joyful Lifestyle**

**Driver assisted system to prevent car accidents and relieve anxiety by understanding human factors of the elderly.**



# Implementation Structure of Nagoya COI

***Project Leader*** : K. Esaki (Toyota Motor )

***Research Leader*** : K. Onogi (Nagoya University)

***Core Institution*** :Nagoya University

***Participating Companies:***

**Asahi Glass, DENSO, Toshiba, Toyota Motor,  
Toyota Central R&D Labs, Panasonic, Fujitsu**

***University and other Institutions:***

**National Graduate Institute for Policy Studies,**

**Tokyo Institute of Technology,**

**Tokyo University of the Arts,**

**Tokyo University of Agriculture and Technology**

**Aichi Prefectural University, **Aichi Prefecture, Toyota City,****

**National Institute of Advanced Industrial Science and Technology,**

**Institute of Physical and Chemical Research**



*National Innovation Complex*

# NCC :National Composite Center

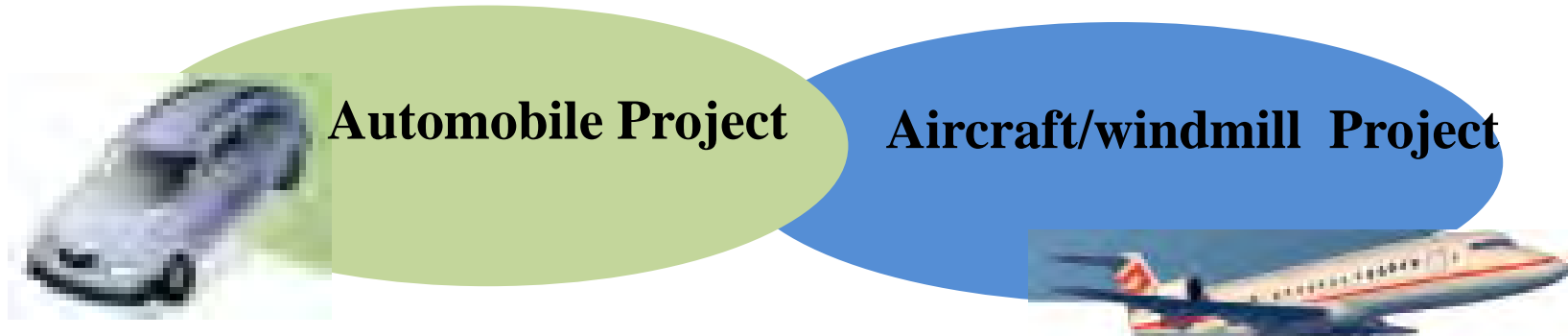
**NCC is an industry-government-academia cooperative base of composite material research, especially carbon fiber reinforced plastic**

**NCC includes two research projects**



**Automobile Project :developing CFRP structural material to reduce automobile weight**

**Aircraft/windmill Project : developing CFRP structural material for aircraft and windmills**



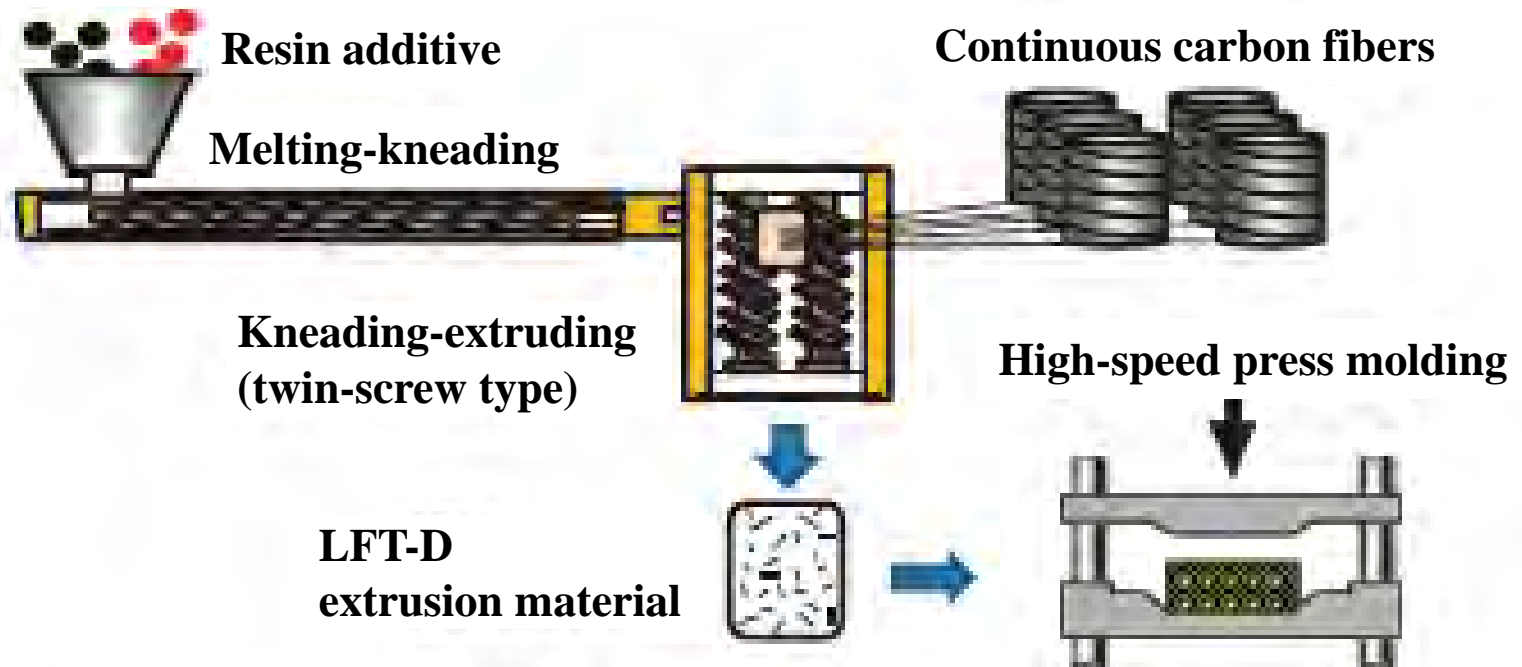


# Challenge to reduce automobile weight with CFRPT

- goals of automobile project are
  - automobile weight reduction
  - low cost LFT-D system

## Large-sized LFT-D forming system

Thermoplastic resin pellet



# NCC provides large scale facilities

## Facilities for automobile project



Large high-speed oil hydraulic press equipment

**Power output 3,500 ton**



Large continuous heating equipment



Biaxial extrusion for LFT-D

# NCC :National Composite Center

## Facilities for aircraft project

### Lighting resistance/ fire and flame resistance equipment

Maximum current of lightning resistance evaluation equipment: 200kA



Lightning resistance evaluation equipment (B/C generator)

Lightning resistance evaluation equipment (A generator)

Lightning resistance evaluation equipment (E generator)

# **NCES :Center for Embedded Computing Systems**

**NCES focused especially on Automotive application**

- large-scale joint projects with **car manufactures and car component suppliers****
- consortium-type joint projects with industries**

**Scope of NCES**

- aiming at practical use in industry**
- development of prototype system/software**
- education and human resource development**

# Industrialized example of NCES's outcome

## Platform embedded in consumer electronics



**EPSON :Printer**



**Panasonic :Karaoke**



**Softbank :Mobile phone**



**Ricoh :Printer**



**Brother: Printer**



**Roland : Audio Equipment**

# Industrialized example of NCES's outcome

## Platform embedded in industrial products



**Jaxa**  
: H2B rocket



**Suzuki :Kizashi**



**Nissan :Skyline hybrid**



**Konica-Minolta**  
: Spectrophotometers



**Jaxa**  
: ASTRO-H satellite



**Okuma**  
: NC device



**Daihen**  
: Welding machine

**Thank you for your kind attention**