

- Tough, Light and Heat Resistant Materials for Aircrafts -

Teruo Kishi

Program Director, CAO



Strategic Innovation Promotion Program

Appointment of the S&T Advisor to the Foreign Minister, 24 September, 2015



Roles of the S&T Advisor to the Foreign Minister

support activities of the Foreign Minister from a S&T perspective / provide advice to the Foreign Minister and the relevant departments on the S&T utilization in various foreign policy-makings while proceeding the formulation of networks among science advisors of other states and the S&T-related personnel.



- Support the activities of the Foreign Minister
- Reinforce networking among S&T advisors, scientists/academics
- Provide advice to the Foreign Minister and the relevant departments on the S&T utilization in various foreign policy-makings

The 5th Science and Technology Basic Plan :

Chap. 3 (1) Sustainable growth and self-sustainable development in regional society

① i) Ensuring stable energy and improving energy efficiency

Further promoting and accelerating R&Ds of energy-saving technologies in transportation industry

Contribution to the environment and energy fields due to improvement of energy utilization efficiency

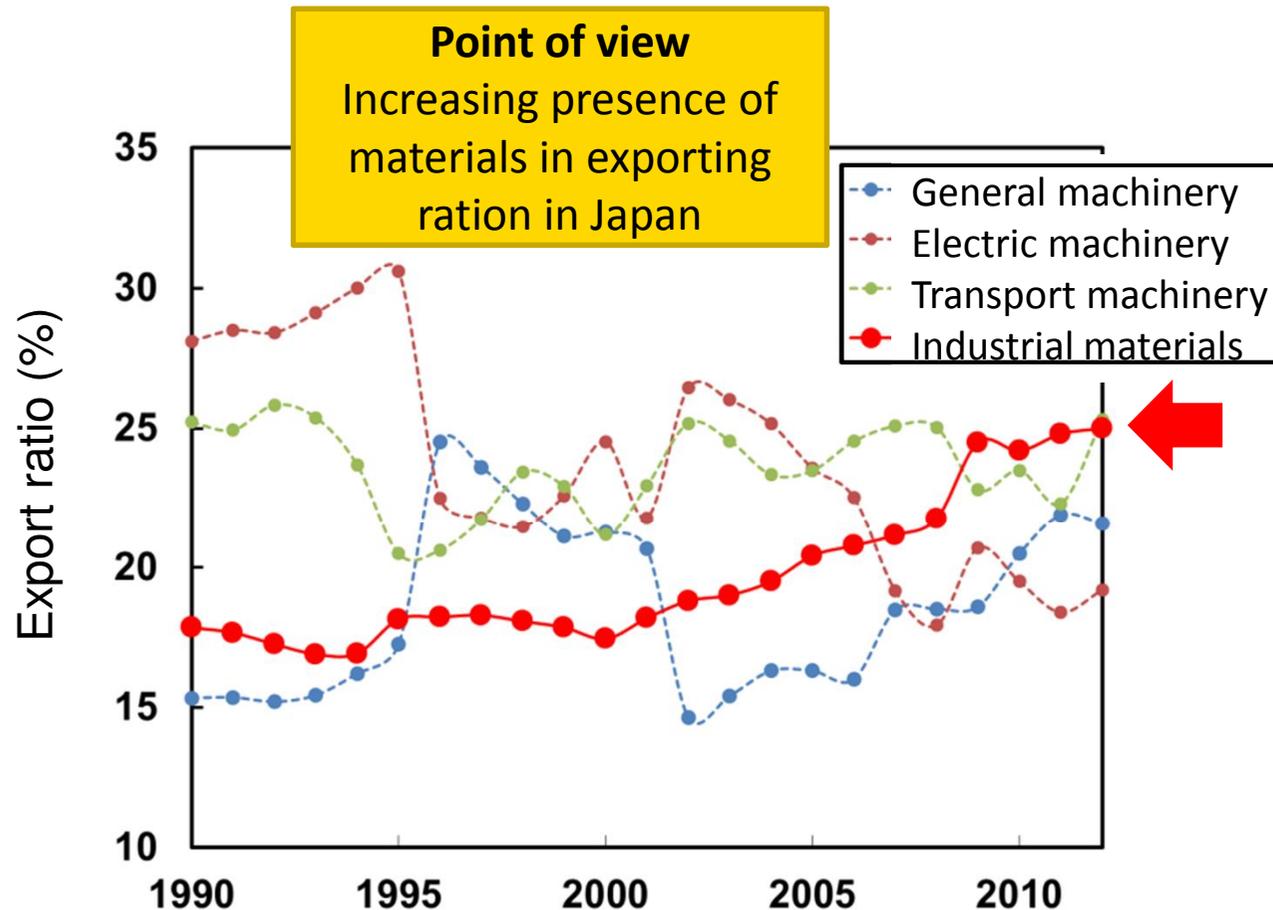
- Strong and light materials → Reduction of energy consumption.
- Tough and resistant to heat → Improvement of combustion efficiency.

Strengthening the global competitiveness of the material industry

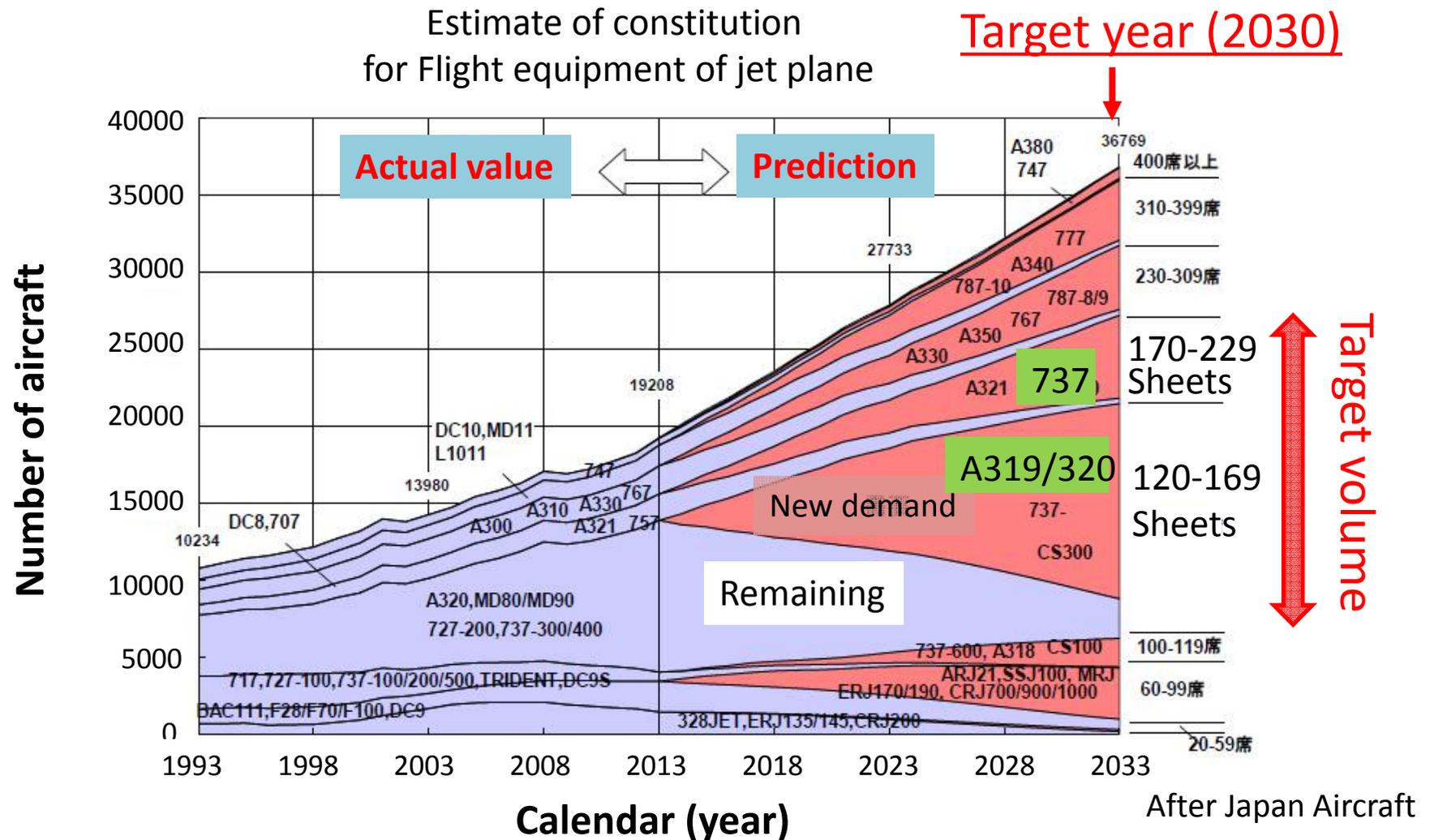
- Aircraft : Resolution of the challenging problems of material technology.
- Material :
 - Development of materials with higher-additional value and/or higher reliability.
 - Higher productivity which emerging nations hardly catch up.
 - Correspondence to high-mix low-volume and shorter-lifecycle production.

Social and Economical Significance of “SIP SM⁴I”

- Keeping the level of International competitiveness of material industries in Japan higher and stronger.
- Building key technologies helpful to improve energy conversion / utilization efficiency.
- Improving competitiveness of Japan’s aviation and material industries related to aircraft components & materials.



Target of Structural Materials for Innovation



Materials & molding processes developed in the SIP will be used in **small & medium-sized aircrafts** produced after 2030.

Structural Materials Research Supported by the Government of Japan

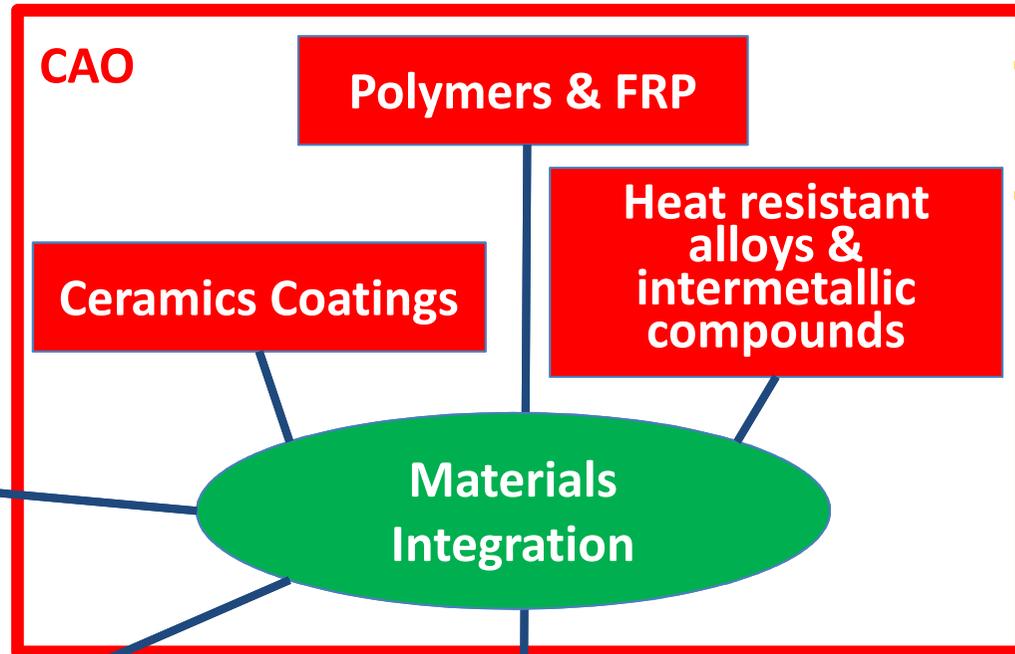
MEXT

Fundamental research

ESISM*
NIMS

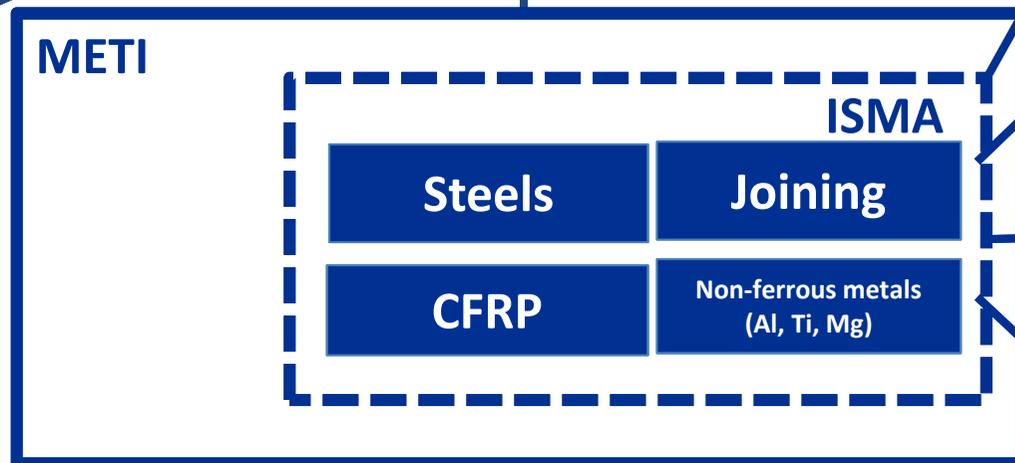
Innovative development

Materials informatics



Power generation

Aircrafts



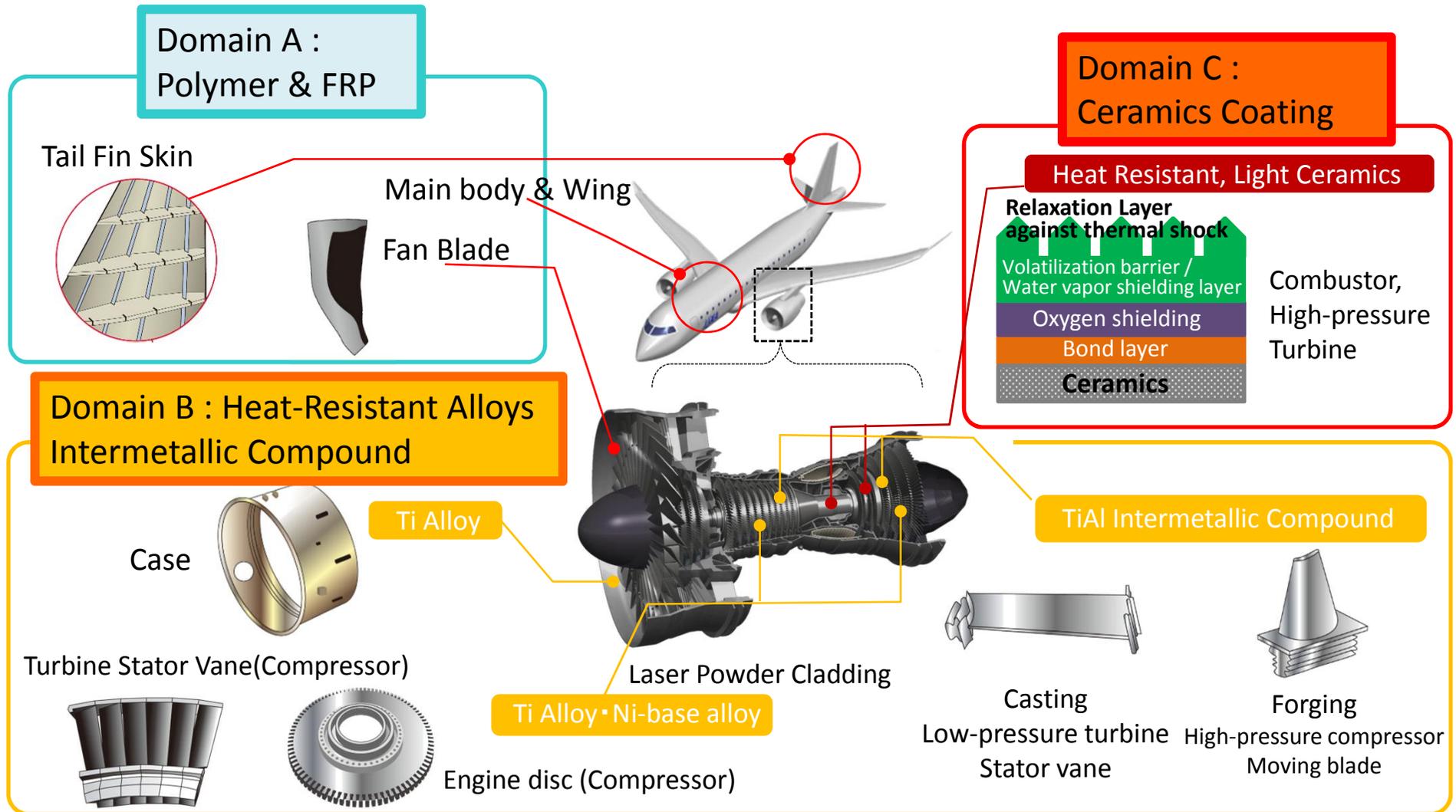
Railway transportation

Auto mobiles

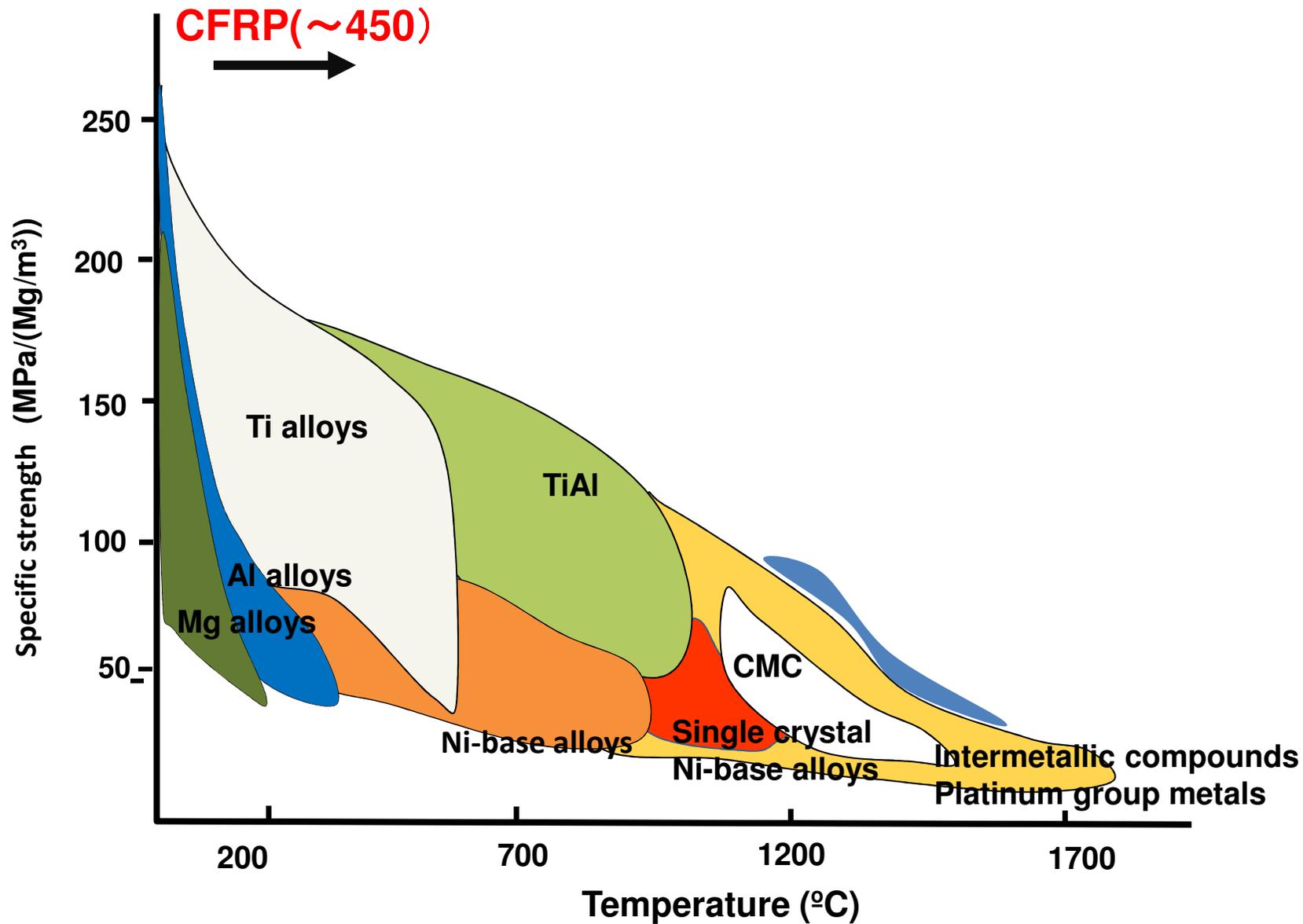
Industrial equipment

*ESISM:
Elements Strategy Initiative for Structural Materials

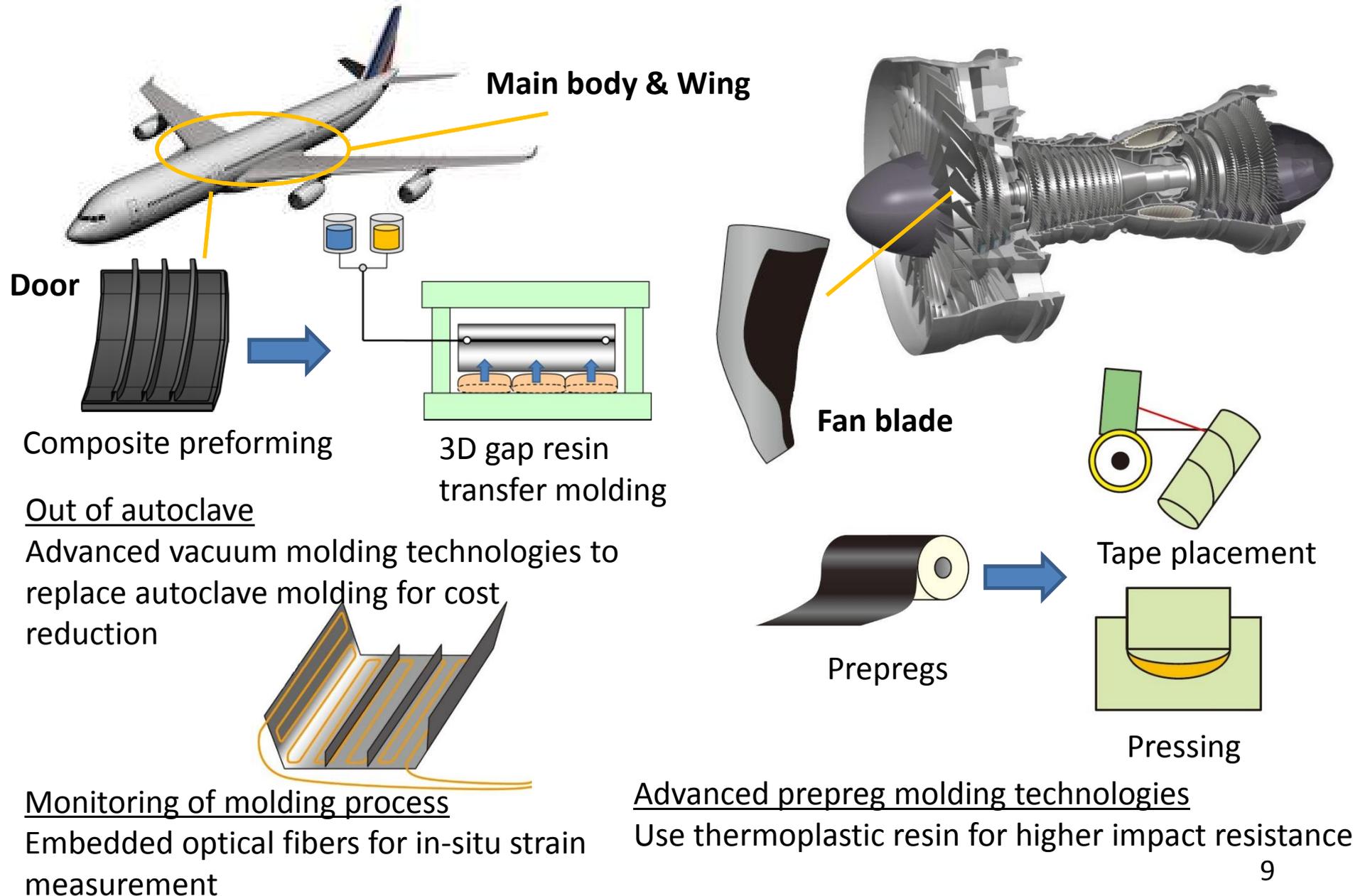
Development of Materials and Processing for Aircraft



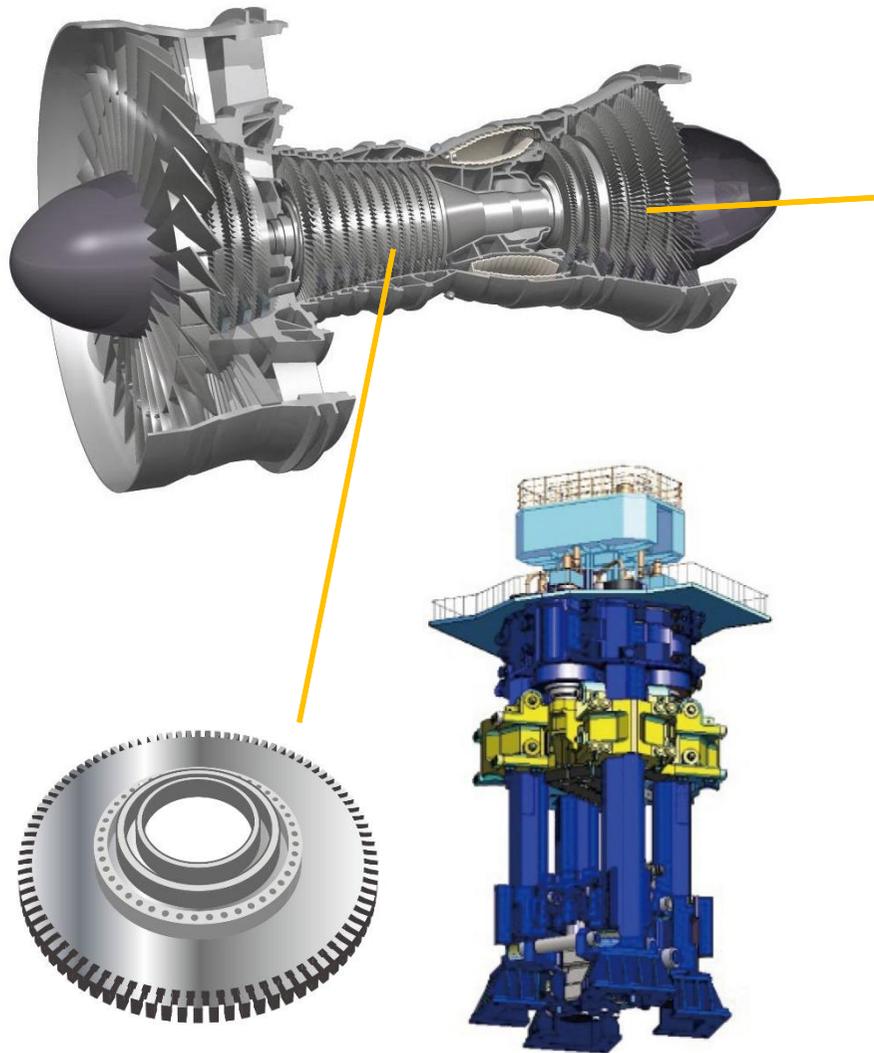
Comparison of Properties of Heat Resistant Materials



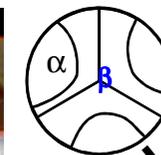
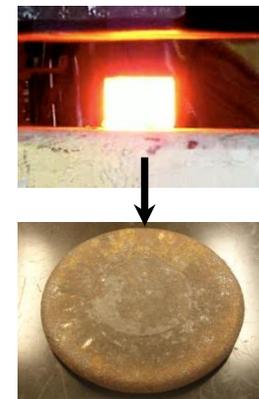
(A) Materials Technologies for CFRP



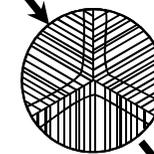
(B) Materials Technologies for Alloys & Intermetallic Compounds



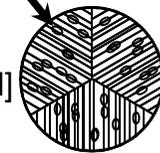
Precision casting for turbine blades
(TiAl intermetallic compounds)



Forgeability



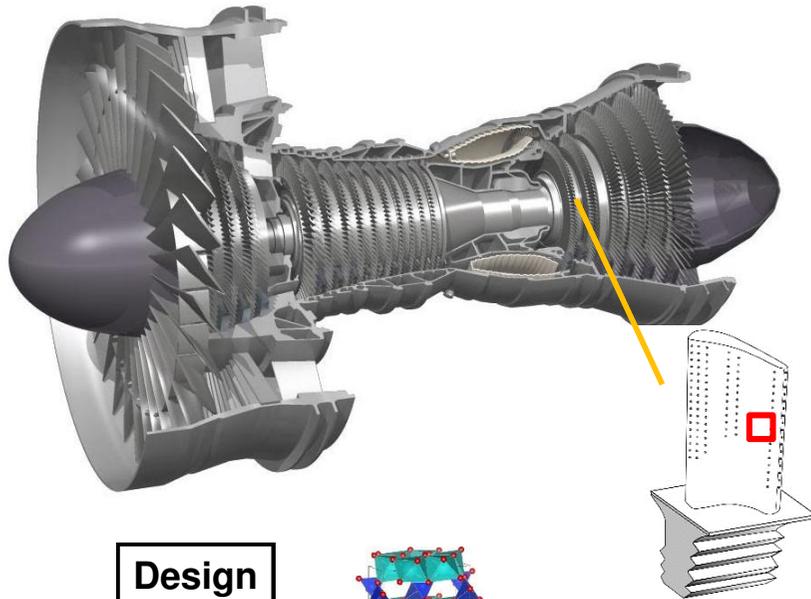
Toughness



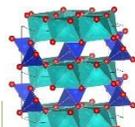
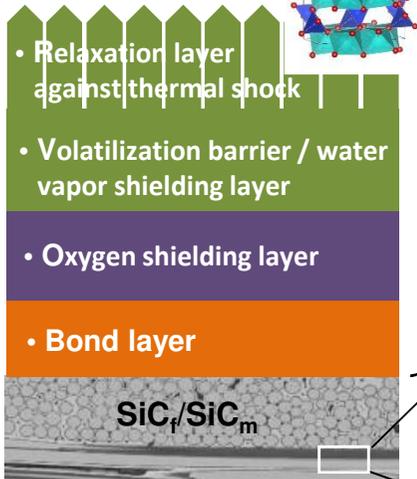
TiAl: both forgeability and toughness are satisfied by utilization of **β phase** [firstly proved in the world]

Advanced forging for discs (Ni-base alloys, Ti alloys)

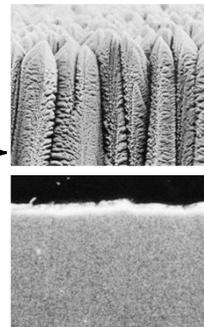
(C) Ceramic Coating Technologies



Design



EBC



- Reaction protective / damage tolerance induced layer

Compatibility of environmental shielding and thermo-mechanical durability

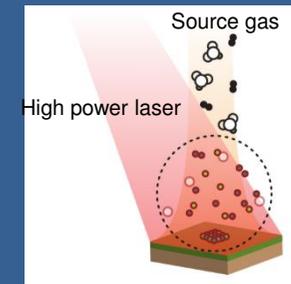
Coating

Electron beam-PVD, etc.

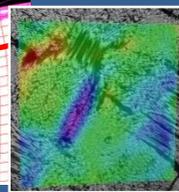
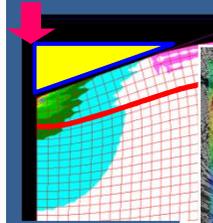


Interface-controlled coatings

Laser CVD, etc.



Performance



Mechanical characteristics and soundness

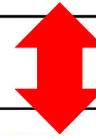
Applicability

(D) Materials Integration (MI) System (for metals)

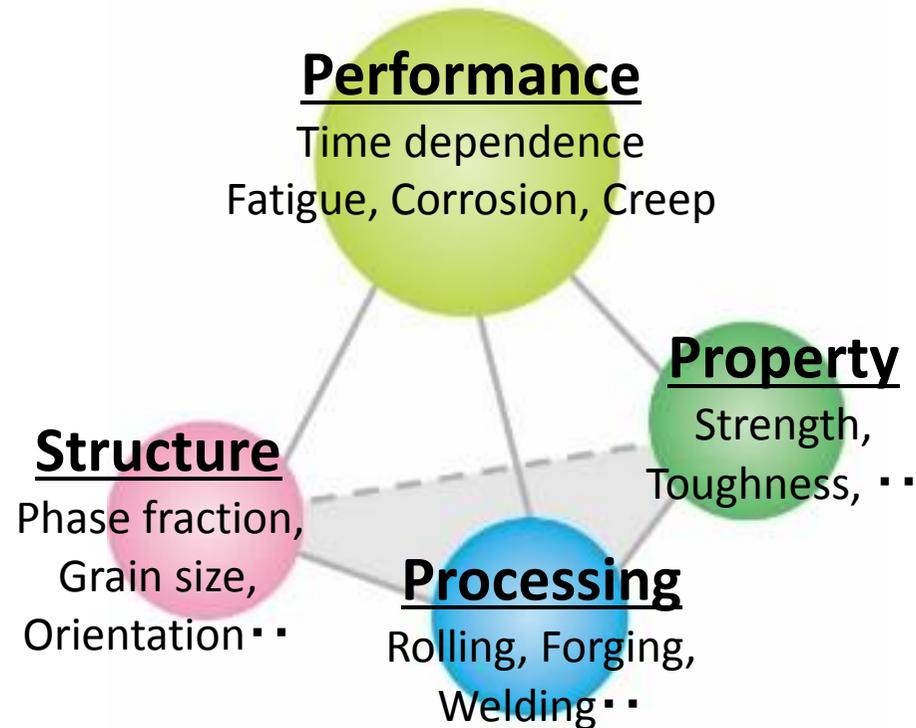
(A) Polymer & FRP

(B) Heat-Resistant Alloys
Intermetallic Compound

(C) Ceramics Coating



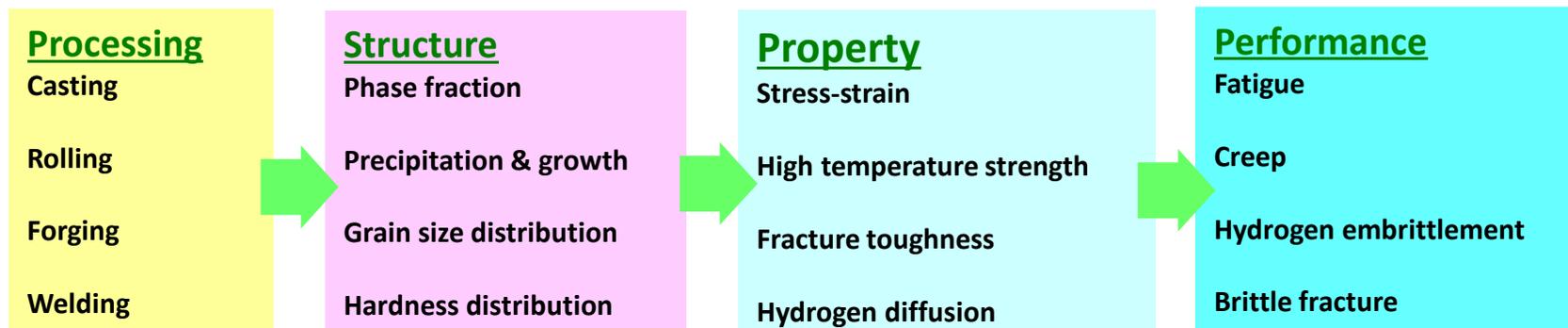
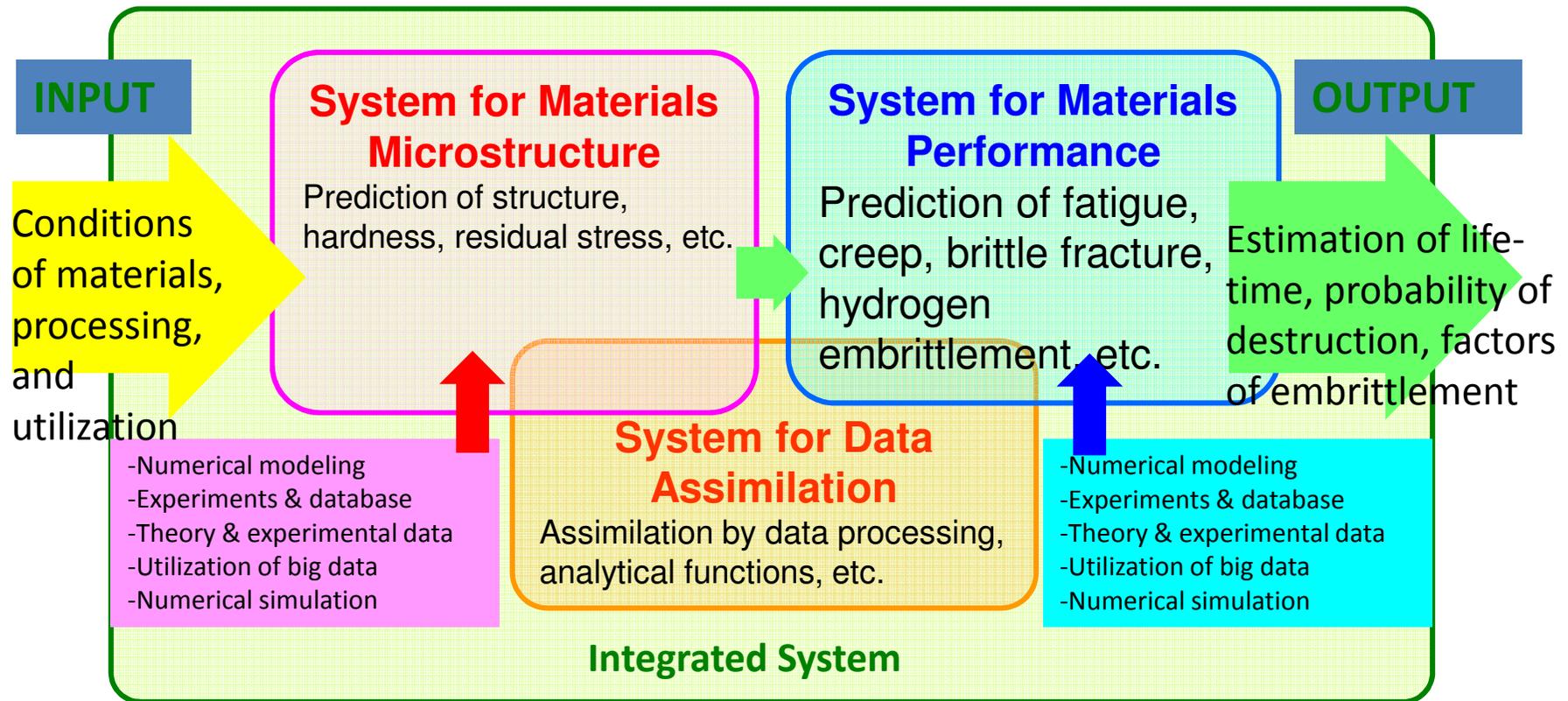
(D) Materials Integration (MI)



Integration of theory, experiments, computation and database contributes to

- Reducing the volume of tests
- Shortening development time
- Optimizing process and material selection
- Predicting reliability of structures

(D) Materials Integration



ご清聴ありがとうございました。

Vielen Dank für Ihre Aufmerksamkeit.