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Development of a linear electron accelerator-based neutron source for analysis of structural materials

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29th Linear Accelerator Conference, LINAC18
Beijing, 17th Sept. 2018

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ISMA
Innovative Structural Materials Association

Project Background: Development of innovative structural materials for the transport industry

Realization of energy conservation society

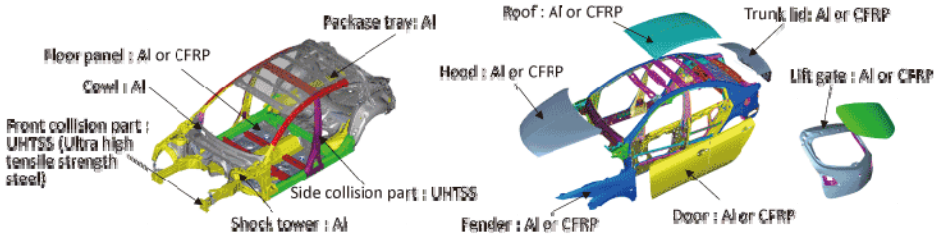
Weight saving of automobiles

- High performance structural material
- Innovative material joining technology

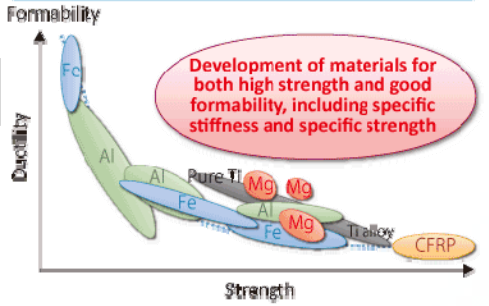
Importance of non-destructive analysis method

- Accelerator-based compact neutron source has promise.

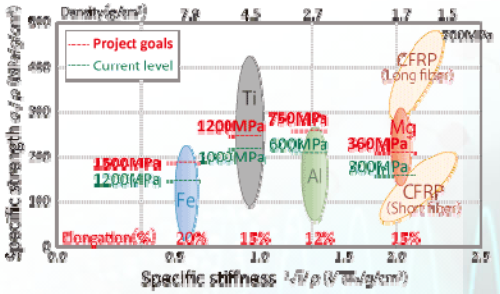
Examples of Multi-material Application for Vehicle Weight Reduction



Examples of Properties of Structural Materials



Specific Stiffness & Specific Strength of Materials



From ISMA Homepage: http://isma.jp/en/index.html

NEDO

Delegated (commissioned) Research Funds

New Energy and Industrial Technology Development Organization (NEDO)

- Material evaluation using neutron beams and multi-material adhesion technology development -

ISMA
Innovative Structural Materials Association

Innovative Structural Materials Association
Member : 38 Companies,
2 National inst. (AIST, NIMS),
1 Univ (Nagoya Uni.)
(as of May 2018)

・Many themes are in progress

Theme52

Three steel companies, one analytics company, AIST
(recommission) NIMS, Hokkaido Univ. TIT, RIKEN, KEK

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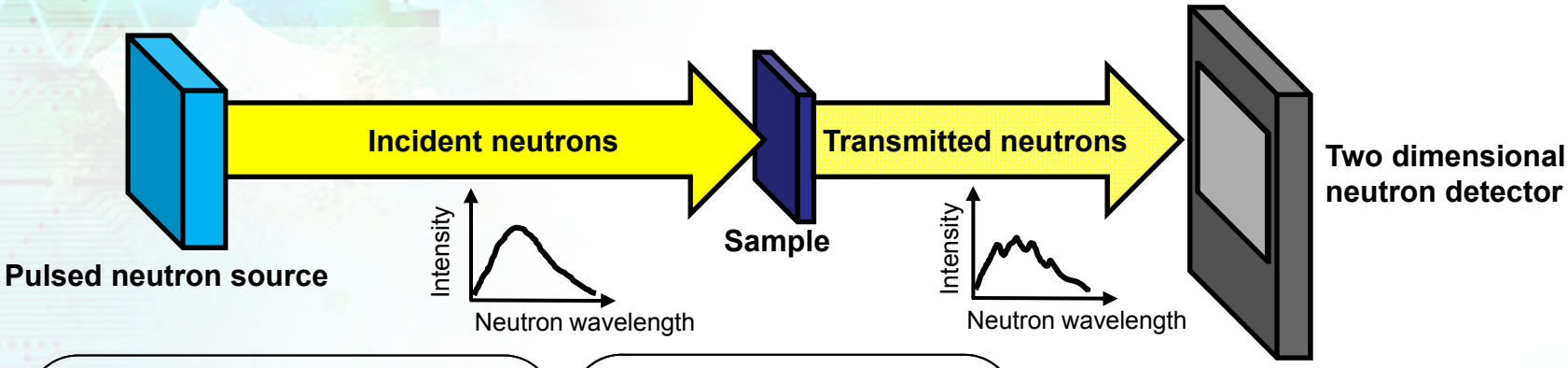
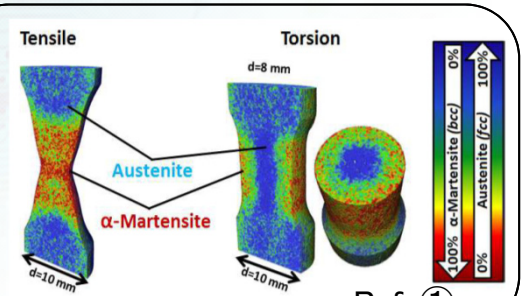
Evaluation Technique: Bragg Edge Imaging

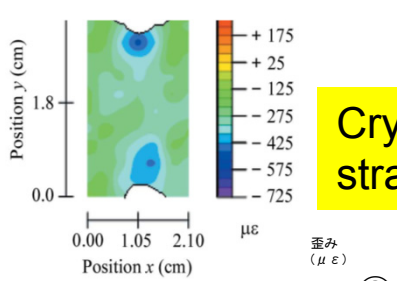


Crystalline phase



Ref. ①

Crystalline strain

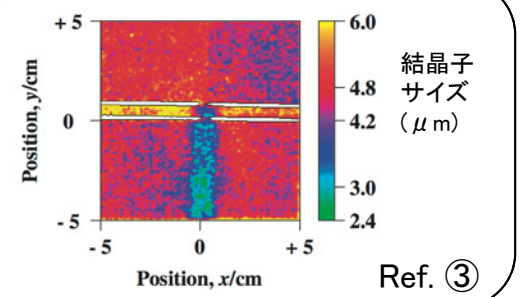


Ref. ②

Bragg edge imaging

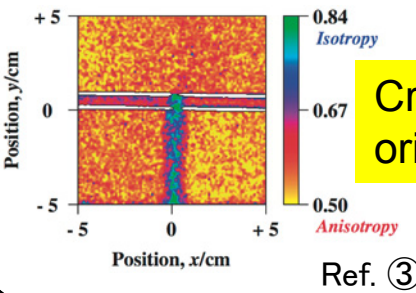
- Various types of information simultaneously
- Easy to understand

Crystal size



Ref. ③

Crystalline orientation



Ref. ③

etc.

① R. Woracek *et al.*, Physics Procedia **69** (2015) 227

② K. Iwase *et al.*, J. App. Crystallography **45** (2012) 113

③ H. Sato *et al.*, Materials Transactions **52** (2011) 1294

Compact source × Bragg edge imaging ➡ Contribution on structural materials

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Overview of the Accelerator Based Neutron Source

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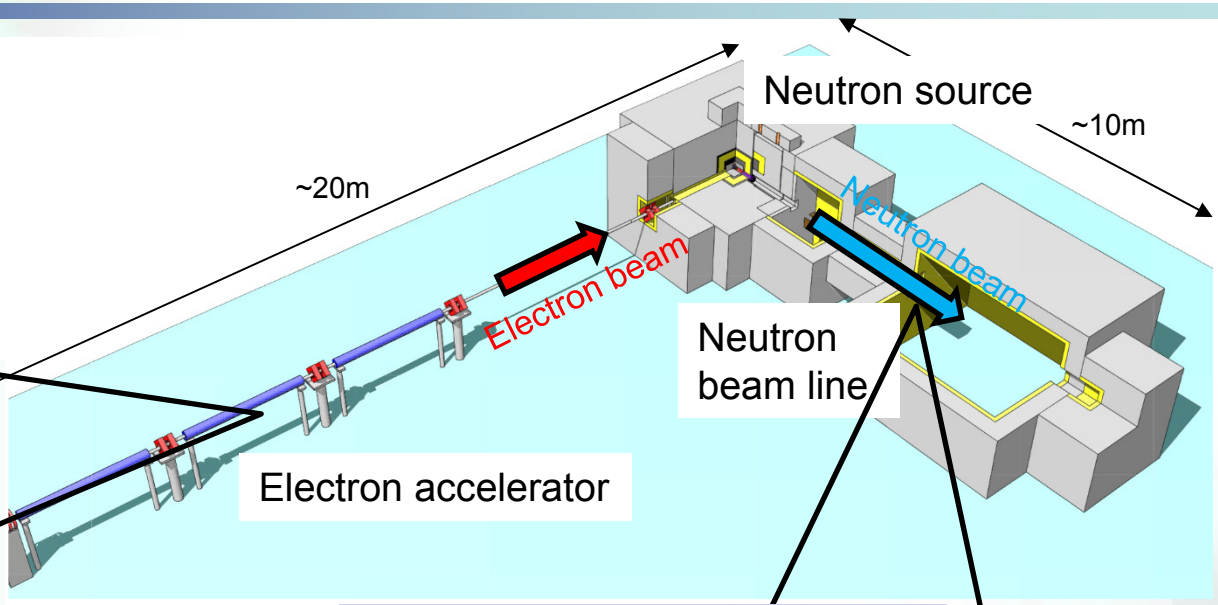

Accelerator

S-band electron accelerator

Total length	~15m
Acceleration Energy	~36.5 MeV
Peak current	~275 mA (Max.)
Beam pulse width	10 μs (Max.)
Repetition rate	100 Hz
Beam power	~10 kW (Max.)

Accelerator tube

Frequency	2.856 GHz
Mode	2π/3
# of Cavity	81
Length	2930（2828）mm
Q-value	>13000

Neutron source, beam line

Optimization for the Bragg edge imaging

(a)	Decoupled moderator (solid methane)
(b)	Flight path length = 8 m
(c)	~ 10 kW electron beam
(d)	Repetition rate = 100 Hz
(e)	High performance 2D neutron detector