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

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e is developing a
gun

Neutrons are a powerful probe of structural materials due to their high penetration. As part of the Innovative Structural Materials R&D project funded by the New Energy and Industrial Technology Development Organization (NEDO), the Innovative Structural Materials Association (ISMA)\textsuperscript{1} is developing a dedicated, compact electron-accelerator based neutron source at the National Institute of Advanced Industrial Science and Technology (AIST) in Tsukuba, Japan, for the characterization of structural materials.

The accelerator is designed to have a maximum electron beam power of \(~10\) kW (\(\sim36\) MeV and \(~275\) mA), which will be incident on a water-cooled Ta target. The electron beam will have a maximum pulse length of around 10 \(\mu\)s at a repetition rate of 100 Hz. Neutrons produced through photo-nuclear reactions will be cooled by a decoupled solid methane moderator. Using this pulsed, low-energy neutron beam we plan to perform various imaging techniques.

### Outline of the Neutron Source

**Klystron**
- Pulse width: 10 \(\mu\)s (max)
- Rep. Rate: 100 Hz (max)
- RF Power: 7 MW (max)

**Electron Gun**
- Acc. Energy:
  - 3 MeV
- RF Input Power:
  - 1.4 MW
- Beam Power:
  - 750 W (Max)
- Installed \(e^+\) gun

**Accelerator**
- RF freq.: 2.856 GHz
- Est. Energy: \(~35\) MeV (Max)
- Beam Current: \(~275\) mA (Max)
- Pulse Width: 10 \(\mu\)s (Max)
- Rep. Rate: 100 Hz (Max)
- Beam Power: \(~10\) kW (Max)

**Neutron Production Target**
- Neutron beam
- Cd coupler
- Solid methane moderator
- Ta target
- Graphite

**construction**
- ~ 20 m
- ~ 10 m

**Neutron Beamline**
- Target
- Cooling Water
- Sample and Detector

**Bragg Edge Imaging**
- Pulsed neutron source
- Bragg edge imaging
- Contribution on structural materials

### Overview

We have optimized the design for Bragg edge imaging
- High power electron beam (Max \(~10\) kW)
- High rep. rate (100 Hz) and short pulse (<10 \(\mu\)s)
- High neutron energy resolution (decoupled solid methane moderator)
- Compact neutron beamline (length: 8 m)

### Industrial Use

- By measuring the intensity of neutrons transmitted through a sample as a function of neutron wavelength (energy) using a large 2-dimensional detector, we can characterize the crystalline phase and strain, crystal size and orientation etc. in a single measurement.
- We plan to apply this technique to various structural materials in order to help with the development of new, lightweight materials for transport vehicles.
- In collaboration with materials manufactures and researchers, we plan to provide a dedicated, user friendly, neutron source for materials analysis.