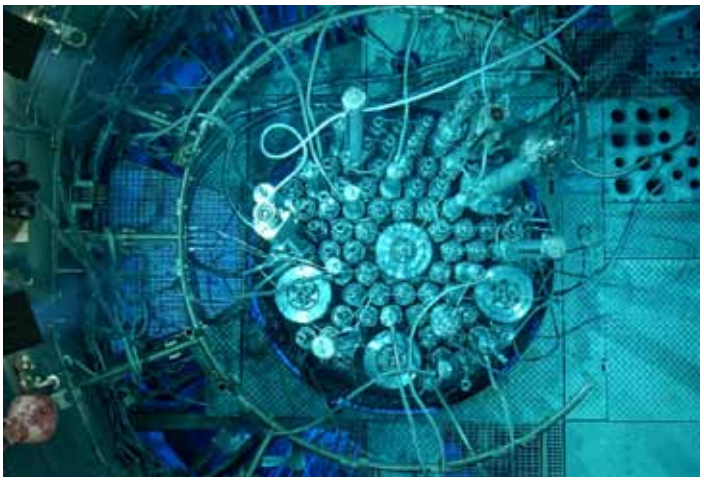
SCK•CEN
STUDIECENTRUM VOOR KERNENERGIE
CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE

Institute for Nuclear Materials Science

The general objective of the institute for Nuclear Materials Science (NMS) is to develop and assess materials for their suitability in nuclear applications. The scope of the activities comprises structural materials, fuels and radioisotopes. The targeted systems are current nuclear installations as well as future applications of nuclear energy.

The overall approach towards the different material challenges combines the experimental study of materials, the mechanistic understanding of the observed behaviour and its implementation in numerical simulations. This enables the prediction of the behaviour of materials in a nuclear environment and contributes to the safe en efficient operation of current and future reactor systems.



Strategic priorities

Structural materials research

NMS evaluates the performance and life span of materials used in current nuclear power plants. The focus is on the ageing phenomena. The main areas of investigation are the radiation induced embrittlement of reactor pressure vessel steel and stress corrosion cracking of internal and primary circuit components. By research and services in this field, NMS contributes to nuclear safety.

Nuclear fuel research for current nuclear power plants

NMS is occupied with the qualification of evolutionary fuels for present-day reactors. This comprises the experimental characterisation of commercial fuel behaviour in normal and transient conditions, supported by validated fuel modelling codes. This know-how is extended by advanced irradiation and post irradiation tests, supported by numerical modelling efforts. The aim is to improve the efficiency and safety in nuclear power plant operation in partnership with the industry.

Structural materials development and validation for advanced nuclear systems

NMS develops and validates materials for advanced fission reactor concepts (Accelerator Driven Systems (ADS), MYRRHA, Generation IV) and for fusion technology (ITER, DEMO). The experimental qualification is supported by multiscale modelling tools. These enable the extrapolation of the results to the expected conditions in the advanced nuclear systems that are currently being designed.

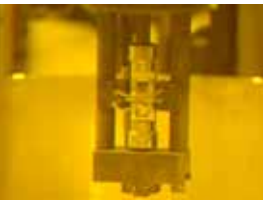
Nuclear fuel research for advanced nuclear systems

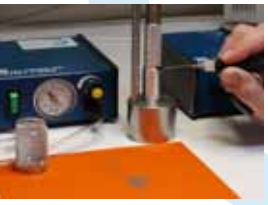
NMS contributes to the development and qualification of new fuels for advanced reactor concepts. In this field, activities are focussed on fuels for material test reactors (MTR) and ADS-LFR and gas fast reactors.

Radioisotopes and silicon doping

NMS is charged with the development of new radioisotopes for medicine and the enhanced neutron transmutation doping of silicon for electronics. The aim is to strengthen the capabilities of the BR2 MTR within the market of industrial as well as radiopharmaceutical irradiation services. The development towards new applications in radiopharmacology aims at setting up production and conditioning methods for short lived isotopes, in close collaboration with producers.

NMS expert groups





Within the institute for Nuclear Materials Science (NMS), 6 expert groups develop and assess new and existing materials for their suitability in nuclear applications. The research is focussed on the scientific (physical, chemical, phenomenological) and technical (experimental, empirical) follow-up and prediction of reliable functioning of the materials in their working conditions.

Structural Materials

- Assessment of embrittlement of reactor pressure vessel steels.
- Testing and analysis of surveillance capsules.
- Evaluation of embrittlement and stress corrosion cracking resistance of core structural materials.
- Fundamental understanding of irradiation damage mechanisms.
- Development and validation of mathematical codes predicting material properties and their evolution in nuclear environments.
- Mechanical properties of both unirradiated and irradiated materials by tensile, impact, fracture toughness, fatigue and creep testing, both in air and aggressive environments (corrosion tests).
- Sample design equipment, including reconstitution techniques.

Fuel Materials

- Qualification of nuclear fuel for present day reactors.
- Development and qualification of new fuels (MTR, ADS-MYRRHA, Gen IV).
- Fundamental understanding of irradiated fuel phenomena through dedicated solid state research of actinide based systems.
- Integral understanding of irradiated fuel phenomena.
- Mechanistic thermo-mechanical fuel performance code applicable to new fuel types.

Belgian Reactor 2

- Operation of the BR2 research reactor.
- Production of radioisotopes for the medical industry.
- Silicon doping for the electronics industry.
- Experimental rigs to test fuels and structural materials.

Microstructural and Non-destructive Analysis

- Hot-cell infrastructure for the non-destructive screening of fuel rods.
- Fuel refabrication/instrumentation equipment to fabricate short rodlets from full-size rods and to encapsulate fuel rod remnants for disposal.
- Extensive set of microscopes addressing both the μ-structure (OM, SEM, TEM, XRD) and μ-chemistry (SEM-EDX, EPMA, XPS) of materials.

Radiochemical Analysis

- Chemical and radiochemical analysis of materials from the nuclear fuel cycle.
- Analysis of typical nuclear related physicochemical material characteristics.
- Support of the BR2 reactor with water control analyses.
- Support of the research programmes by determining the (radio-)chemical composition of materials and process liquids.
- Infrastructure for chemical sample preparation, including laboratories equipped with hot-cells, glove boxes and fume cupboards, to support experimentation on radioactive samples.

Infrastructure Operation

- Taking care of mechanical and electrical/ electronic aspects of all research infrastructures within all institutes.
- Management of nuclear materials flows within the NMS institute (transports, accountancy, waste).

Contact
info@sckcen.be
www.sckcen.be