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Irradiation of Be- and Li-Based Materials for Application in ITER TBM

Thursday 4 September 2025 14:00 (30 minutes)

A set of different Test Blanket Module (TBM) concepts will be installed on ITER to validate the design and operation in nuclear fusion environment of Breeding Blanket technologies for fusion facilities. The European solid breeder blanket concept HCPB to be tested at ITER uses advanced ceramic breeder (ACB) material containing lithium (Li) in the form of pebbles and Beryllium (Be) material in the form of pebbles [1].
Beryllium is required for neutron economy. In addition to pure Be, the intermetallic compounds such as TiBe12 and CrBe12 beryllides were proposed as alternative solution thanks to their improved properties, including lower swelling, superior mechanical strength, and better suitability for industrial-scale production. The first irradiation study of Be and TiBe12 back in 2000-2005, is reviewed in [2] and it highlights superiority of the titanium beryllide over pure Be. Recently, a new batch of Be, TiBe12 and CrBe12 has been produced and its qualification including response to the neutron irradiation is necessary.
For the fuel supply, the biphasic Li4SiO4/Li2TiO3 ceramics are proposed as reference tritium breeder ceramics for the European solid breeder blankets for ITER and DEMO [3]. The advantage of these composites is resistance of grain growth against long-term annealing and maturity of the high-throughput production beyond lab scale. Just as in case of newly produced beryllides, the investigation of the response of the advanced Li ceramic pebbles to the neutron irradiation and prove of the breeding capability is required.
This presentation reviews the latest irradiation experimental campaign which has been set at Belgian Nuclear Research Centre as one of the elements in the qualification process of functional materials for ITER TBM. The talk will cover the main elements of design space (scope-time-budget), safety aspects (tritium, chemical compatibility, build-up of gas pressure) to deploy the experiment and during the experiment, cross-border nuclear transportation aspects and finally waste disposal considerations.

References:
[1] F.A. Hernandez et al., Fusion Energy Technology R&D priorities (2025) 225-234.
[2] V. Chakin et al., Nuclear Materials and Energy 42 (2025) 101910.
[3] O. Leys et al., Fusion Engineering and Design 164 (2021) 112171.

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