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P4.180 Radiation damage and helium accommodation in lithium metatitanate as a ceramic breeder material

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Lithium metatitanate (Li2TiO3) is one of the leading candidates for application as a breeder blanket material for the helium cooled pebble bed (HCPB) concept.

During operation, transmutation of lithium contained within the blanket material as a result of neutron capture produces both tritium and helium. For efficient tritium production, high ceramic density is desirable in order to increase the overall lithium atom density per unit volume, thereby increasing the probability of interaction between fusion neutrons and lithium atoms. Ceramic breeder materials must also withstand long-term exposure to high energy neutron irradiation and the high operating temperatures associated with fusion reactors.

While a substantial amount of research has been carried out concerning tritium diffusion and release from candidate ceramic breeders, comparatively little is known about the mechanisms of helium accommodation in these materials or the influence of helium on tritium diffusion.

In this work, Li2TiO3 has been synthesised by solid state synthesis and novel sol-gel synthesis methods. Variation of post-synthesis sintering conditions has been employed to produce ceramics with different microstructural properties. Selected samples have been implanted with heavy ions (Ti+) to induce displacement damage analogous to that caused by fusion neutrons, and helium ions to simulate the production of helium within the ceramic.

The purpose of this work is to identify the influence of ceramic microstructure (e.g. grain size, morphology, porosity) on radiation damage resistance and helium accommodation/gas bubble formation in candidate ceramic breeder materials.

In this contribution we report evidence of structural modifications resulting from ion implantation, and the observed behaviour of implanted helium in Li2TiO3 following characterisation by X-ray diffraction, Raman spectroscopy and transmission electron microscopy.

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