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Characterization of advanced concepts for first wall materials by plasma exposure in the linear plasma device PSI-2

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Tungsten is envisaged as plasma-facing material in fusion reactors because of its small tritium retention and low erosion rate as well as its high melting point and high thermal conductivity. However, its intrinsic and operation-induced brittleness and the unacceptably high oxidation rate at high temperatures pose challenges for manufacturing, component lifetime and safety. The development of new advanced material concepts such as new tungsten alloys and composites produced via powder injection molding, self-passivating tungsten alloys produced via field assisted sintering technology and fiber reinforced tungsten composites produced by powder metallurgy or chemical vapor deposition, may help to overcome these issues.

To support a fast route for production of plasma facing components, the characterization of these advanced materials under fusion relevant loading conditions is needed. Plasma exposure in linear plasma devices under synergistic particle and transient heat loads offers the opportunity to investigate the plasma compatibility of the new material concepts at an early stage of development.

In this contribution, we report on first experiments in the linear plasma device PSI-2 to assess erosion rates, fuel retention and damage thresholds of advanced tungsten based alloys and composites in deuterium and mixed deuterium-helium and argon/neon plasmas. Under these conditions, advanced material concepts based on tungsten do not show significantly degraded plasma compatibility with respect to reference tungsten material.

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