

MEASUREMENTS OF TRITIUM SOLUBILITY IN THE EUTECTIC LEAD-LITHIUM ALLOY

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The interaction of tritium with the lithium bearing coolant and breeder material is one of the most important physical processes in determining the feasibility and the attractiveness of a fusion energy system because it is fundamentally linked with all aspects of plant operation, from fueling to power extraction and safety. The INL Fusion Safety Program has started an experimental campaign to measure the fundamental transport properties of tritium in the lead-lithium eutectic as part of the collaborative research under the US/Japan TITAN program, focused on measurement of hydrogen isotopes solubility in static configurations. The material is supplied by Atlantic Metals Co., and has a nominal composition of 15% Li in moles (Pb-15Li). Eutectic composition and impurities concentration of two batches used in the experiments was measured by ICP-AES and ICP-MS analysis.

This paper reports on results obtained with hydrogen and tritium in the temperature range between 300 C and 700 C and input pressure above the liquid surface ranging from 10 Pa to 100 kPa. Other parameters have been varied between tests, including the surface to volume ratio of the liquid column and the eutectic composition. Several modifications of the system configuration have been adopted during tests to improve the data accuracy, including: i) heating system (resistive, induction), ii) crucible material (alumina, quartz, refractory metals), iii) measurements technique and relative instrumentation (pressure manometers, gas chromatography for hydrogen, proportional radiation counters for tritium). A discussion of the interaction of the alloy with the various crucible materials tested is included in light of the influence on the solubility results, as well as a detailed comparison with available references.