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Design, synthesis and characterization of Li4SiO4-based solid solutions as advanced tritium breeders

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The breeding blanket is a key component of the fusion reactor since it involves tritium breeding and energy extraction, both of which are critically important for the development of fusion power. Different lithium based ceramics have been studied as attractive tritium breeder materials, Li4SiO4 has been selected as one of the most promising candidates for solid tritium breeding materials in fusion reactors because of its high lithium atom density, its high melting temperature and favorable tritium release behavior. Li4SiO4-based solid solutions: Li4+x(Si1−xAlx)O4 and Li4Si1-xTixO4 were prepared as advanced tritium breeder to improve the mechanical property, irradiation resistance and reduce the tritium retention. Different Li4SiO4-based solid solutions powders and pebbles containing aluminum and titanium were prepared by solid state reactions and Modified melt-spraying process. Phase analysis, microstructures and density of the ceramics were determined by XRD, SEM and Archimedes' method. Impedance spectroscopy was measured to evaluate the electrical conduction properties of the ceramics. The thermal conductivity was determined using a laser flash device. Tritium release performance in Li4+x (Si1−xAlx)O4 and Li4Si1-xTixO4 irradiated with thermal neutron was studied by out-of-pile annealing experiments. These facts would represent the following advantages to use Li4SiO4-based solid solutions in blanket system of D-T fusion reactor that the thermal conductivity is higher and tritium inventory is lower in Li4SiO4-based solid solutions than those in Li4SiO4.

Keywords: Li4+x (Si1−xAlx) O4, Li4（Si1-xTix）O4, thermal conductivity, the mechanical property, tritium release performance

Eligible for student paper award?

No

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