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Experimental Study on Multilayer Liquid Metal Film Flow Characteristics under Horizontal Magnetic field

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The liquid lithium has been considered as a suitable selection for the plasma facing component (PFC) materials in fusion reactors because of its plenty of advantages for removing the heat fluxes, incident tritium and impurity effluxes, and enabling a lithium wall fusion regime. However, under a complex magnetic field, the flowing liquid metal will exhibit complicated flow characteristics induced by the action of extra Lorentz force, which named magnetohydrodynamic (MHD) effect. Some preliminary experimental and numerical studies have proven that the flow resistance increased dramatically, the surface wave of film flow changed greatly, and liquid film cannot cover the whole solid surface with the existence of magnetic field. Because of the above deficits, it is hardly to form a uniform, stable lithium film in the Tokamak environment. In this paper, we make an attempt to make up the disadvantages on liquid metal film under magnetic field. A newly built liquid film generator with eight outlets distributed in different heights to form eight layers short liquid films, which connect one after another to form a long liquid film, is used to test the feasibility of our idea on the production of ideal liquid film. The Galinstan, at liquid sate in room temperature and low toxicity, is chose to substitute the lithium in our experiments. Experimental results show that this kind of film generator can enhance the spreading performance of liquid metal on solid surface and reduce the flow resistance induced by a magnetic field. A preliminary analysis is also carried and an evaluation of using this kind of liquid film generator as PFC in real fusion device has been conducted to lead some further studies.

Eligible for student paper award?

No

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