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Experimental study on MHD effect of liquid metal sheath jet for the liquid metal divertor REVOLVER-D

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A new concept of the liquid metal limiter/divertor, REVLOVER-D, which uses multiple free-falling jets of liquid tin as a target, has been proposed. This concept can accommodate the high heat load of several tens of MW per square meter, whereas formation of the stable continuous flow is one of key issues. To avoid the transformation of the jets into droplets due to surface tension instability, "sheath-jet" concept, i.e., insertion of an internal flow resistance (IFR) (e.g., wires, tapes, and chains) to stabilize the flow, has been considered. In order to investigate the flow characteristics of the liquid metal sheath jet including the influence of the magnetohydrodynamics (MHD) effect, experiments using a liquid metal circulation device has been conducted.
In this experiment, a low melting point alloy, U-alloy78 (Bi57-In17-Sn26 with the melting point 78 degree Celsius) is used as a simulant of tin to reduce the issues in the temperature management and the material compatibility with the flow channel. Free-falling jet of U-alloy78 with a height of ~1 m and a maximum flow rate of ~9 L/min is generated using a magnet pump. The attachment equipped with a two parallel plate magnet has been installed and can provide the magnetic field perpendicular to the flow direction with ~0.2 T. Electric current can be applied to the jet by a direct connection or a TIG-type arc discharge. The tilt of the jet due to Lorentz force has been observed with an electric current of the order of 1 A. Dependence of the flow characteristics on the flow rate, magnitude of the electric current, and the shape or material of the IFR has been investigated.
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