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Thermoelectric-driven Flow of Liquid Lithium in Solid Metal Trenches: a New Plasma-Facing Component for Fusion Devices DAVID N. RUZIC, DANIEL ANDRUCZYK[1], DAVIDE CURRELI, SOONWOOK JUNG, MICHAEL PETER CHRISTENSON, KYLE LINDQUIST, PETER FIFLIS, WENYU XU, CPMI, Department of Nuclear, Plasma and Radiological Engineering, University of Illinois at Urbana-Champaign, Urbana 61801 USA — The new LiMIT device (Lithium/Metal Infused Trenches) recently proposed [D. N. Ruzic, et al., Nucl. Fusion 51, 102002 (2011)] is an innovative plasma-facing component able to naturally self-adapt its cooling capabilities depending upon the heat flux from the plasma. The system uses the thermoelectric forces arising from the strong temperature gradients and magnetic fields of the divertor region, to obtain a JxB MHD drive of the liquid lithium into small solid-metal trenches. A number of cooling channels guarantee the temperature gradient between the hot plasma-facing liquid surface and the cool solid-metal assembly comprising the trenches. A prototype of the device has been built and tested in the electron-beam-based SLIDE facility at Illinois and diagnosed by means of an IR camera and embedded thermocouples. The flow velocity of liquid lithium has been measured using a fast-frame camera, monitoring the motion of small particles deposited on the liquid lithium surface. Velocities of the order of several centimeters per second have been observed, compatible with a simplified 1D model and more accurate 3D TE-MHD (Thermoelectric Magnetohydrodynamics) computations. LiMIT is planned to be tested at Magnum-PSI (The Netherlands), EAST (China) and in the new TELS facility at Illinois.

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