Present Status of Liquid Metal Research for a Fusion Reactor

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Liquid Metals (LM) offer unique properties as Plasma Facing Materials for a Fusion Reactor. They are practically free from permanent damage by neutron and plasma irradiation and can be re-circulated and regenerated for lifetime and particle and heat exhaust issues. These properties have motivated intense research activity, with a variety of concepts, elements and proposals for practical implementation in a future Fusion Reactor [1]. However, many aspects still remain unresolved and integration of these proposals into a realistic scenario may be challenging.

Although lithium is by far the best-known liquid metal applied to fusion device and has produced outstanding improvements in confinement, concerns about tritium retention and elevated vapour pressure still exist. Tin has emerged as a feasible alternative due to the lack of these issues, but its high Z poses concerns about plasma contamination. The confinement of a liquid metal in a porous mesh has been put forward to prevent splashing of the liquid under Electro-Magnetic forces, but wetting of the mesh by the metal is not a trivial issue and efforts to develop the best combination taking into account corrosion aspects are still ongoing. The choice of first wall material in a liquid metal PFC scenario has to be made considering the recovery of the evaporated metal as well as the interaction between the ionized LM species and the wall material in terms of sputtering and fuel retention, among other issues.

In this presentation, a review of ongoing activities worldwide will be given. The different options in terms of liquid metal choice (Li, Sn. Ga, LiSn alloys, etc…), power handling capabilities, retention of H isotopes, plasma contamination and stability of a liquid in a tokamak environment will be addressed. A special effort will be devoted to describe the activities performed at the Ciemat facilities, including exposure of liquid metals and alloys to TJ-II stellarator plasmas through the CPS Liquid Lithium Limiters and Liquid Metal probes and experiments at the laboratory devoted to the recovery and integration aspects.

References:

1] M Ono and the ISLA Team. Nucl. Fusion **52** (2012) 037001