

The Liquid Lithium Wall/Divertor Pathway to Fusion Energy

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There are many proven engineering and scientific benefits in using LiLi covered walls/divertors in magnetic fusion devices of the Tokamak type [1]. The divertor is protected, the recycling of the cold plasma near the wall is reduced, the confinement time is improved, off-normal disruptions such as ELM's disappear, temperature and density profiles become more favorable. There is an overall improvement in fusion efficiency and the fusion scaling laws become significantly more favorable. The main idea is to reduce energy losses to walls, instead of increasing the input power which is much more expensive and also more damaging to plasma stability. In the LiWallFusion approach, plasma is externally controlled and becomes fundamentally stable: no ELMs, no MHD activity, no RE.

The net result is that fusion becomes both feasible from the scientific point of view and affordable from the economic point of view, because of the resulting compactization and better maintainability of the device when Lithium walls are used.

The present white paper deals with two aspects of the Lithium Wall Fusion concept. First, it proposes to accelerate research on the design and experimentation with prototypes of highly controlled flowing or self-contained liquid lithium divertor systems[2,3,4] in order to eventually integrate them ASAP in active tokamaks such as NSTX -

U, ALCATOR (that operates routinely at reactor level power densities), EAST, etc.. In this context effort should be invested also in understanding the plasma-lithium interactions as function of plasma species, energy and incidence angle.

Second, it proposes to investigate the implications of the Lithium Wall approach to the design of Fusion Pilot Plants that are planned to operate in the post-ITER era[5], including possibly ITER itself.

From the research results until now it is clear that the adoption of the Li Wall approach will result in a better, cheaper and faster fusion energy programme. To achieve this, I propose to implement a more aggressive Lithium Wall/Divertor Fusion programme.

[1] A. Sternlieb, L.E. Zakharov, E. Mazzucato, 2nd Int. Symp. on Li, PPPL, USA, 2011.

[2] L.E. Zakharov, ASIPP, Hefei, China, July 2011

[3] M.Ono, PPPL report- 4808, 2012

[4] M.A.Jaworski, PPPL Seminar, March 2013

[5] J.E. Menard et.al., Nucl. Fusion, 51, 2011