原子能科学技术　2007 41 (增刊2): 397-406　ISSN: 1000-6931　CN: 11-2044/TL

结构材料及核材料性能

中国液态锂铅包层材料研究进展

黄群英1，李春京1，李艳芬1，刘少军1，宋勇1，彭蕾1，章毛连1，朱志强1，高胜1，郭智慧1，王永亮1，吴宜灿1，周新贵2，万发荣3，单以银4，郁金南5，朱升云5，张品源5，杨建锋6，李合琴7，巨新3，室贺健夫8，长坂琢也8，大贯惣明9，FDS团队1

1.中国科学院 等离子体物理研究所，安徽 合肥 230031 2.国防科技大学，湖南 长沙410073
3.北京科技大学，北京〓100083 4　中国科学院 金属研究所，辽宁 沈阳〓110016
5　中国原子能科学研究院，北京〓102413 6　西安交通大学，陕西 西安〓710049
7　合肥工业大学，安徽 合肥〓230009 8　日本国立聚变研究所， 歧阜 土歧〓509　5292，日本
9　北海道大学 工学部，札幌〓060　8628，日本

收稿日期 2007-11-15 修回日期 2007-12-15 网络版发布日期: 2008-1-20

摘要　液态锂铅包层是国际上普遍关注和最有发展潜力的聚变堆包层概念设计之一，而包层材料是液态锂铅包层的核心问题之一。目前，液态锂铅包层普遍选用低活化铁素体/马氏体钢（RAFM钢）作为结构材料，液态锂铅作为中子倍增剂及氚增殖剂。另外，部分设计采用了耐高温、电绝缘流道插件作为功能材料，以降低磁流体动力学效应及提高冷却剂出口温度（高于700 ℃）。为适应液态包层的发展需求，中国科学院等离子体物理研究所FDS团队联合国内外相关研究单位，进行了具有中国自主知识产权的中国低活化马氏体钢（CLAM钢）及液态锂铅包层功能材料研发，并开展了锂铅热对流及强迫对流回路的设计、研制及腐蚀实验研究，以研究液态金属锂铅的流动特性及其与结构和功能材料的相容性。同时建立了聚变堆材料数据库平台，为促进中国聚变堆液态包层及材料技术的研究和发展提供数据支持。

关键词　液态包层；中国低活化马氏体钢；锂铅回路
分类号　TL62；TL627；TL34

Research and Development Status of China Liquid Li Pb Blanket Materials

1.Institute of Plasma Physics, Chinese Academy of Sciences, Hefei 230031, China;
2.National University of Defence Technology, Changsha 410073, China;
3.University of Science and Technology Beijing, Beijing 100083, China;
4.Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, China;
5.China Institute of Atomic Energy, Beijing 102413, China;
6.Xi'an Jiaotong University, Xi'an 710049, China;
7.Hefei University of Technology, Hefei 230009, China;
8.National Institute for Fusion Science, Toki 509 5292, Japan;
9.Faculty of Engineering, Hokkaido University, Sapporo 060 8628, Japan)

Abstract The liquid Li-Pb blankets have become the most promising conceptual blankets in the world. Materials selection and development are one of the key issues for liquid Li-Pb blankets. Currently, the reduced activation ferritic/martensitic (RAFM) steels are chosen as the candidate structural material and liquid Li-Pb as neutron multiplier and tritium breeder. And in some designs, the flow channel insert (FCI), which can bear high temperature and have low electric conductivity, is adopted as the functional material to enhance the coolant outlet temperature and reduce the magnetohydrodynamic (MHD) pressure drop. In order to meet the requirement of liquid blanket development, the China low activation martensitic (CLAM) steel and functional materials for liq

uid blanket are being developed in Institute of Plasma Physics (ASIPP), Chinese Academy of Sci ences under wide collaboration with other institutes and universities in domestic and overseas. Me anwhile, liquid Li- Pb thermal and forced convection loops were designed, manufactured and corr osion experiments were carried out to study the flow characteristics and the compatibility of liqui d Li Pb with structural and functional materials. In addition, a fusion material data management s ystem was built to be a useful tool to accelerate the research and development on fusion blanket d esign and material technology.

Key words liquid blanket _ China low activation martensitic _ functional materials _ Li-Pb- loop

DOI

通讯作者