激光增材制造高强度铝合金阻裂与强韧化

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摘要：以探月、火星探测、空间站建设等为代表我国航天事业正蓬勃发展。铝合金激光增材制造(Selective Laser Melting, SLM) 较好地契合了航天领域对材质轻量化、结构镂空轻量化的迫切需求，有望成为下一代运载火箭、卫星等核心零部件成形的关键技术。因此，开发出新一代增材制造高强铝合金，已经成为当前航天增材领域亟待完成的一个重要基础研究任务。在国家重点研发计划、国家自然科学基金的支持下，与中车开展合作，针对现有增材制造商用铝合金性能不足难题，提出基于层错能效应发展增材制造铝镁合金新型强韧化机理。针对易裂问题，从SLM铝镁合金的热裂机理出发，揭示了合金成分与凝固应力敏感性因子、层错能及力学性能的关系，发现了激光增材制造高镁含量铝合金中存在 9R相。通过抑裂机制-层错能效应强韧化机制-成分设计-疲劳性能-构件质量控制的系统研究，制备了屈服强度 530MPa，拉伸强度 570MPa，延伸率 14%的增材制造铝合金。研发的铝合金粉末已成形出 200×200mm的复杂零件，且通过疲劳性能测试，在中车工业获得应用验证。

关键词：激光增材制造；选区激光熔化；铝合金

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