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CrCoNi 中熵合金表面激光熔覆制备耐磨 CrCoNi-(Ti, Al)中熵合金涂层研究

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CrCoNi 中熵合金因具有稳定的 FCC 单相结构及优异的低温拉伸性能，已成为最引人注目的新型材料之一，具有广阔的应用前景。但目前关于 CrCoNi 合金的研究更多集中于铸态合金，在此材料上激光熔覆中熵合金涂层的研究极少，对其组织、结构与性能的认识还不清晰。为了改善 CrCoNi 合金的表面力学性能，本研究采用激光熔覆技术在其表面成功制备了三种中熵合金涂层，分别为 CrCoNi、CrCoNi-Ti 和 CrCoNi-Al 涂层。研究结果表明，CrCoNi 涂层主要由具有典型外延生长特征的柱状晶（FCC 结构）组成；CrCoNi-Ti 涂层的组织具有等轴晶形貌（FCC 结构），晶内出现了高密度的亚结构；CrCoNi-Al 涂层主要由具有等轴晶和柱状晶交替分布的层状结构（BCC 相）组成，且存在少量 FCC 相。硬度测试显示，CrCoNi、CrCoNi-Ti 和 CrCoNi-Al 涂层的硬度相较于基体硬度(254.9 ±5.7 HV)分别提升了 7.3%、77.4%、209.6%。摩擦磨损实验表明，相较于基体，CrCoNi 涂层的耐磨损性能没有提升，而 CrCoNi-Ti 和 CrCoNi-Al 涂层的磨损率则分别提升了 14.1%和 39.7%。对磨损表面的分析显示，基体与涂层的磨损机理均为粘着磨损、磨粒磨损和氧化磨损。综合分析发现，CrCoNi-Ti 和 CrCoNi-Al 涂层的硬度与耐磨性的提升，可归因于添加 Ti 和 Al 后产生的固溶强化、第二相强化、晶界强化和非均匀变形诱导强化的共同作用。

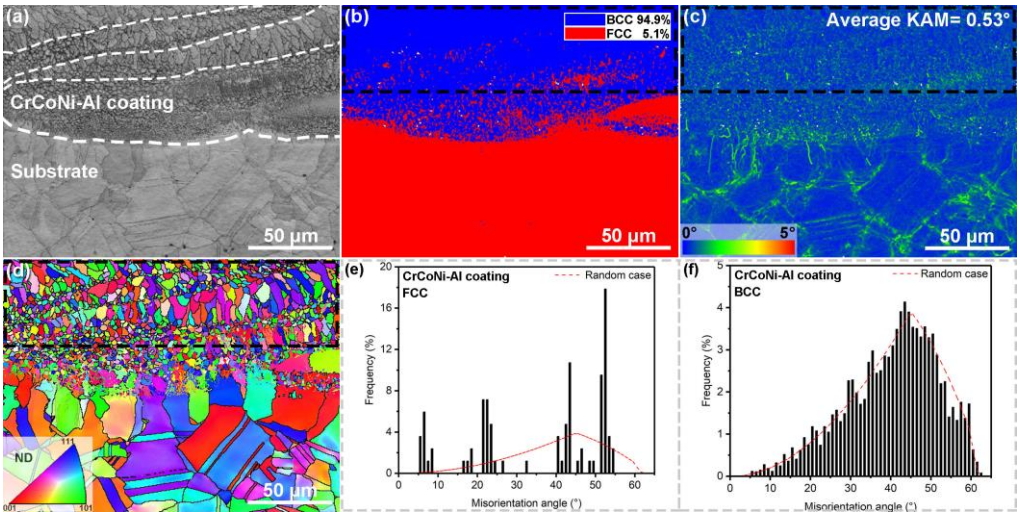

Fig. 1 Results of EBSD analysis of CrCoNi-Al coating

关键词： CrCoNi；激光熔覆；中熵合金涂层；硬度；耐磨性

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