硅钢板表面等离子喷涂 60%Al_2O_3-TiO_2涂层的组织与性能

摘要

等离子喷涂是一种热涂覆工艺，采用由直流电驱动的等离子电弧作为热源，需要通过将加热软化的颗粒喷射到基板上来产生涂层。喷射的颗粒通常为粉末形式，将其注入等离子火焰中以加热至高温。颗粒被加速然后被推进到材料表面，在材料表面迅速冷却以形成涂层。本课题使用硅钢板作为基体材料，选择 60%Al_2O_3-TiO_2作为喷涂材料，采取 600A、650A、700A、750A 四种不同电流大小作为变量参数，进行等离子喷涂。对喷涂涂层的微观组织结构进行观察，对涂层截面的显微硬度、涂层的孔隙率、结合强度和热冲击性能等进行了测试分析，最终对工艺参数进行分析，得出最优工艺参数。实验结果分析：采用等离子喷涂在硅钢表面制备的涂层随工艺参数的不同呈现不同的厚度、孔隙率和显微硬度，涂层结构较为致密，呈颗粒状分布；涂层的显微硬度最高为 1165.43HV，厚度最高为 59.6μm，涂层和基体之间结合强度较高。对实验结果进行分析和计算后发现，喷涂时电流越大会使涂层的性能越好，硬度越高。实验后发现采取的最佳工艺为 750A 电流大小的喷涂。

关键词：等离子喷涂，绝缘陶瓷涂层，显微硬度

Microstructure and properties of plasma sprayed ceramic coating on silicon steel surface

Abstract

Plasma spraying is a thermal coating process in which a plasma arc driven by a direct current is used as a heat source, and it is necessary to produce a coating by spraying heat-softened particles onto a substrate.The sprayed particles are typically in powder form which is injected into a plasma flame to heat to a high temperature.The particles are accelerated and then advanced to the surface of the material where they rapidly cool to form a coating.In this paper, silicon steel plate is used as the base material, 60% Al_2O_3-TiO_2 is selected as the spraying material, and four different current sizes of 600A, 650A, 700A and 750A are used as the variable parameters for plasma spraying.The microstructure of the spray coating was observed. The microhardness of the cross section of the coating, the porosity of the coating, the bonding strength and the thermal shock performance were tested and analyzed. Finally, the process parameters were analyzed to obtain the optimal process parameters. The experimental results show that the coating prepared by plasma spraying on the surface of silicon steel exhibits different thickness, porosity and microhardness depending on the process parameters. The coating structure is dense and granular, and the microhardness of the coating is the highest. 1165.43HV, the maximum thickness is 59.6μm, and the bonding strength between the coating and the substrate is high.After analyzing and calculating the experimental results, it is found that the larger the current during spraying, the better the performance of the coating and the higher the hardness. After the experiment, the best process was found to be 750A current spray.

Key words: plasma spraying, insulating ceramic coating, microhardness