双向复合振动辅助磁力研磨加工的试验研究

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摘 要：目的 进一步提高研磨加工效率，并获得更好的工件表面质量。**方法** 提出双向复合振动（磁极垂直于加工表面的法向超声振动和平行于加工表面的切向振动相结合）辅助磁力研磨法实现对工件表面的研磨抛光。以钛合金工件为研究对象，进行了四种不同工况的研磨加工试验，并对试验结果进行了对比和分析。**结果** 采用双向复合振动辅助磁力研磨法研磨钛合金工件，研磨加工 60 min 后，工件表面粗糙度值 *Ra* 由研磨前的 3.78 μm 降至 0.36 μm，有效去除了原始加工纹理，获得了较好的表面形貌。工件表面的残余应力由拉应力转化为压应力。**结论** 双向复合振动辅助磁力研磨法既能增加磁性磨粒的瞬时研磨压力，提高研磨加工效率，又能促进磁性磨粒的翻滚与更替，随时改变磁性磨粒的切削刃和切削方向，使磁性磨粒的运动轨迹互相交织，去除工件表面材料更均匀，同时还能有效地改善工件表面的应力状态。

关键词：磁力研磨；法向超声振动；切向振动；双向复合振动；表面质量；加工效率
中图分类号：TG580 **文献标识码：**A **文章编号：**1001-3660(2018)07-0125-07
DOI：10.16490/j.cnki.issn.1001-3660.2018.07.017

Experimental on Bidirectional Composite Vibration-assisted Magnetic Abrasive Finishing

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ABSTRACT: The work aims to improve the grinding efficiency and obtain better surface quality of the workpiece. A bidirectional composite vibration (combination of normal ultrasonic vibration perpendicular to the finished surface with tangential vibration parallel to the finished surface of magnetic pole) assisted magnetic abrasive finishing method was proposed to realize the grinding and polishing on the surface of the workpiece. The titanium alloy workpiece was taken as the research object, the grinding experiment under four different conditions was carried out and the test results were compared and analyzed. When bidirectional composite vibration assisted magnetic abrasive finishing method was used to grind the titanium alloy workpiece, the surface roughness of the workpiece decreased from *Ra*=3.78 μm to *Ra*=0.36 μm after 60 minutes of grinding. The original processing texture was effectively removed and the surface morphology was better. The residual stress on the surface of the workpiece was transformed from tensile stress to compressive stress. The bidirectional composite vibration assisted magnetic abrasive grinding method can increase the instantaneous grinding pressure of magnetic abrasive particles and improve the grinding efficiency, as well as to promote the rolling and replacement of magnetic abrasive particles. The cutting edge and cutting direction of the magnetic abrasive particles can be changed at any time to ensure the trajectories

收稿日期：2018-01-15；修订日期：2018-03-31
Received：2018-01-15；**Revised**：2018-03-31
基金项目：辽宁省自然科学基金项目（20170540458）
Fund：Liaoning Provincial Natural Science Fund Project (20170540458)
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