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基于研磨氧化锆陶瓷的金刚石/铁磁性磨粒制备研究

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摘 要：目的 为解决氧化锆陶瓷研磨困难这一问题，制备一种新型磁性磨粒。**方法** 采用粘接法制备金刚石/铁磁性磨粒，探究制备工艺中不同成分配比对其研磨性能的影响。通过扫描电子显微镜对磁性磨粒进行表面形貌分析，结合氧化锆陶瓷板件的研磨试验，采用表面粗糙度测量仪与3D超景深显微镜对研磨前后的工件表面质量作对比分析，以此来评价磁性磨粒的研磨性能，最终确定较优的磁性磨粒制备工艺参数。**结果** 压制力为0.3 MPa，混料与粘合剂质量比为10:1，粘合剂中6101环氧树脂、有机硅树脂与651固化剂质量比为4:1:5时，磁性磨粒的切削刃数、粘合剂自身的粘接强度及耐热性都达到了最佳的工艺参数。使用此磁性磨粒研磨40 min后，氧化锆陶瓷板件的表面粗糙度由原始Ra1.493 μm降至Ra0.116 μm，有效去除原始表面缺陷和加工纹理，改善表面质量。**结论** 在粘合剂中加入有机硅树脂可解决研磨相在铁基体上把持力不足的问题，采用此粘接法所制备的金刚石/铁磁性磨粒能够顺利完成对超硬氧化锆陶瓷材料的加工，金刚石/铁磁性磨粒可以作为性能优良的磨削介质参与研磨，并能够满足磁粒研磨光整加工的要求。

关键词： 氧化锆陶瓷；磁性磨粒；金刚石微粉；粘接法；研磨性能

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Preparation of Diamond/Iron Magnetic Abrasive Particles Based on Grinding Zirconia Ceramics

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ABSTRACT: The work aims to prepare a new type of magnetic abrasive particles to solve the problem of processing zirconia ceramics difficultly. Diamond/Iron magnetic abrasive particles were prepared by bonding method. The effect of different composition ratio on the abrasive properties in the preparation process were investigated. The surface morphology of magnetic abrasive particles was analyzed by scanning electron microscopy (SEM). Combined with the grinding zirconia ceramics plate, the surface quality of the workpiece before and after grinding was compared and analyzed by surface roughness measuring instrument and 3D ultra-depth-of-field microscope. So the grinding performance of magnetic abrasive particles can be evaluated, and finally to determine the better preparation process parameters of magnetic abrasive particles. When the pressing force was 0.3 MPa, the mass ratio of mixture to binder was 10:1, and the mass ratio of 6101 epoxy resin, organosilicon resin and 651 curing agent was 4:1:5, the cutting edge number of magnetic abrasive particles, and the bonding strength and high-temperature resistance of magnetic abrasive particles reach the optimum technological parameters. After 40 minutes grinding with the magnetic abrasive particles, the surface roughness of zirconia ceramics plate was reduced from Ra1.493 μm to Ra0.116 μm. The original surface defects and process texture were removed effectively, and the surface quality was improved. Adding organosilicon resin in binder can solve the problem, which holding force of the abrasive phase on the iron matrix is not enough. The Diamond/Iron magnetic abrasive particles prepared by this bonding method can process super hard zirconia ceramics materials successfully. It can be used as a good grinding medium in grinding, and the requirements of magnetic abrasive finishing can be met.

Key words: zirconia ceramics; magnetic abrasive particles; diamond powder; bonding method; abrasive properties

氧化锆具有肌肤亲和性及良好的触摸手感，广泛用于人造牙齿等需要人体亲密接触的领域[1]。相比于玻璃，氧化锆陶瓷具有超强的抗折强度、超常的断裂韧性及良好的刚性、高耐磨性、对信号无屏蔽性等多方面优点[2,3]，适用于手机外壳等电子产品中，随着无线充电和5G的普及，对氧化锆陶瓷的表面质量要求与日俱增。

磁粒研磨光整加工技术是将带有切削刃的磁性磨粒置于工件与永磁体或电磁体之间，磁性磨粒在磁场力作用下互相吸引、排列并形成具有一定韧性的磨粒刷，磁体自转并带动磨粒刷转动、待加工工件与磨粒刷产生相对移动，在转动与移动的配合运动中使磁性磨粒在待加工工件表面形成运动轨迹，实现对具有划痕、皱褶、麻点等缺陷的工件产生挤压、微小划擦、微量切削的目的，从而达到理想的研磨加工效果[4,5]。磁性磨粒作为磁粒研磨技术中的刀具，其性能的优劣直接决定工件最终的表面质量[6,7]。陈燕[8]等将

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