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磁粒研磨中单颗磁性磨粒磁场力的实验研究

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摘要: 为了解决单颗磁性磨粒其磁场力难以定量分析和测量的问题, 本文通过对现有磁场力理论进行分析, 利用特斯拉仪对永磁极轴线方向上的磁场强度进行测量, 并利用MATLAB对磁场强度的实际测量值进行数值拟合, 得出了磁场强度关于加工距离的函数曲线, 进而获得磁场强度变化率的函数曲线, 以其代替理论公式中的磁场强度梯度推导得出了便于定量分析的磁性磨粒所受磁场力的数学模型。同时设计了一种单颗磁性磨粒磁场力的测量装置, 在磁化后磁性磨粒磁场力的作用下, 精密电子天平上永磁极的重量发生改变, 其改变量即为一定体积磁性磨粒的磁场力, 通过体积比计算出单颗磁性磨粒磁场力的大小。结果表明, 在1.5、3.5、5.5、7.5和9.5 mm处, 相同体积、磁场强度下的数学模型计算值和实际测量值均方根误差为0.01366, 验证了该数学模型的准确性。

关键词: 磁粒研磨; 单颗磁性磨粒; 磁场力; 磁场强度; 数值拟合; 体积比

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Experimental Study on the Magnetic Field Force of a Single Magnetic Abrasive Particle in Magnetic Grinding

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Abstract: In this paper, in order to solve the problem that it is difficult to quantitatively analyze and measure the magnetic force of a single magnetic abrasive particle, the existing magnetic force theory was analyzed, the magnetic field intensity along the axis direction of the permanent magnetic pole was measured with Tesla instrument, and MATLAB was used to fit the actual measured value of the magnetic field strength. The function curve of the magnetic field intensity with respect to the processing distance was obtained, then the function curve of the change rate of magnetic field intensity was acquired, which was used to replace the magnetic field gradient in the theoretical formula, and the mathematical model of the magnetic force on the magnetic abrasive particles was deduced, which is convenient for quantitative analysis. At the same time, a single magnetic abrasive particle magnetic field force measurement device was designed. Under the action of the magnetic field force of the magnetic abrasive particles after magnetization, the weight of the permanent magnetic pole on the electronic balance changed. The change of the weight of the permanent magnetic pole was the magnetic force of a certain volume of magnetic abrasive particles. The magnetic force of a single magnetic abrasive particle was

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