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激光拉曼光谱法测定金刚石复合片残余应力

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摘要: 采用显微拉曼光谱仪对直径为25.4 mm、总厚度为3.2 mm的刀具用金刚石复合片(PDC)层表面和侧面不同位置的残余应力进行测试, 获得PDC金刚石层表面径向及侧面的应力分布。然后, 用电火花切掉PDC的硬质合金基体, 再测定金刚石层表面的拉曼光谱, 从而得出金刚石层的微观残余应力。研究表明: PDC表面中间部分的应力为压缩应力, 最大值约600 MPa, 从中心到边缘逐渐降低, 在离边缘2 mm左右变为拉应力; 边沿拉应力的产生是基体的厚度较小, PDC朝金刚石层方向弯曲造成的; 金刚石层侧面的应力为拉应力, 最大值达580 MPa, 位置靠近PDC界面, 这是PDC出现金刚石脱层的主要原因之一; 实验测得的PDC微观应力为62.5 MPa。

关键字: 金刚石复合片; 拉曼光谱; 残余应力

Micro-Raman stress of polycrystalline diamond compact

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Abstract: The residual stresses on the top surface and side face of the diamond layer of polycrystalline diamond compact (PDC) with 25.4 mm in diameter and 3.2 mm in thickness were measured using Micro-Raman Spectroscopy, thus the stresses and their radial and vertical distributions were obtained. To evaluate the magnitude of the thermal residual microstress in the diamond layer of PDC, the tungsten carbide substrate of PDC was cut by electric discharge machining (EDM), and several Raman measurements were performed on the top surface of the diamond layer. The results show that the stresses in the central part of the diamond surface are compressive, the maximum stress is about 600 MPa, the magnitude of the stress decreases from the center to the edge of PDC, and at about 2 mm near the edge of PDC, the stress becomes tensile; the stresses on the side face of the diamond layer are tensile, and the maximum is about 580 MPa near the interface. This tensile stress is thought to be one of the main factors to cause delamination of PDC used for cutting tools; the measured value of the microstress in the diamond layer is about 62.5 MPa.

Key words: polycrystalline diamond compact (PDC); Raman spectroscopy; residual stress

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