

300M 钢回火酸浸蚀检查标准试块的研究

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研究了 300M 钢过热表面的特征, 制作了 300M 钢回火酸浸蚀检查用的标块, 该标块具备过热表面的所有特征, 经实际检验, 效果较好。

The Study on the Standard Sample in Etch Inspection of Tempered 300M Steel

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The characteristics of overheat in 300M Steel was studied. The standard sample in etch inspection was produced. The sample was practical in checking the etch solution.

一、前 言

300M 钢能获得广泛的应用, 除与其优良的性能有关外, 也与在加工中保证其表面完整性至关重要。在零件结构尺寸和材料性能一定的情况下, 机械加工表面完整性是影响零件疲劳寿命的关键因素。不同的加工方法和工艺参数会在材料表面层内产生不同的冶金物理变化。例如, 对于轴承钢、渗碳钢、高强钢和超高强度钢, 不正确的加工会使材料产生过热, 出现过回火和重新淬火现象。为了防止过热现象, 300M 钢零件加工过程中必须严格控制切削参数, 并发展了回火酸浸蚀检查技术。该技术将加工零件浸入酸溶液中, 以过回火和未回火马氏体组织所反映出来的颜色决定零件的合格与报废。

影响酸浸蚀检查结果的因素很多, 其中酸液的活性是一个重要因素。为了检验酸液是否合格, 必须用一种带有过热缺陷的试块即标准试块来检验溶液。国外的酸浸蚀检查标准中^[1~3]均规定了用带有过热缺陷的 300M 钢标块检查溶液合格后, 才能进行酸浸蚀检查。国内“300M 钢零件回火酸浸蚀检查工艺说明书”^[4]中也规定了在进行酸浸蚀检查时, 应该用 300M 钢制造的带有过热缺陷的标块检查酸浸溶液合格。

本研究工作就是为了满足这一要求, 对 300M 钢的过热表面和所制作的标块的特性进行了分析。

二、试验结果和分析

1. 过热表面的特性

图 1 示出了 300M 钢淬火后经不同温度回火后的浸蚀颜色。淬火后的组织为马氏体, 其颜色为金属本身的亮白色(左 1)。300℃回火后为正常的低温回火马氏体, 其颜色为浅灰色(左 2)。400℃回火为有碳化物明显析出的马氏体, 其颜色为稍深的灰色(左 3), 500℃、600℃回火为回火索氏体, 其颜色分别为黑灰色和黑色(左 4 和左 5)。700℃回火后颜色又转为黑灰色(左 6)。

表 1 列出了不同温度回火后的浸蚀颜色与硬度值的对应关系。

表 1 不同温度回火后的浸蚀颜色与硬度

回火温度, °C	不回火	300	400	500	600	700
酸浸颜色	白	灰	深灰	黑	黑	黑灰
硬度(HRC)	>54	54~52	51~49	48~46	45~43	33~30

实际零件由于加工条件不同, 所形成的过热表面可能有多种形式。但归纳起来过热表面主要分为三个区, 即未回火区(重新淬火区)、过回火区和正常区。这主要由加工过程中产生的热量密度和散热情况决定。一般情况是, 在某一区域温度最高, 在这一温度区域四周温度渐次降低。

实际零件的过热表面可能表现为以下两种形式:

(1) 在某一区域产生的热量使金属的温度超过奥氏体相变点, 冷却后便形成重新淬火的马氏体组织, 在这一区域四周由于温度渐次降低, 依次形成高温、中温和

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6. The sixth part of the document includes a list of references to the sources used in the study. It provides a comprehensive overview of the literature on the topic and highlights the contributions of the current study.

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9. The ninth part of the document is a list of acknowledgments. These recognize the contributions of individuals and organizations that have supported the study and provided assistance throughout the research process.

10. The tenth part of the document is a list of abbreviations. These provide a key for the symbols and acronyms used throughout the document to ensure clarity and consistency.

11. The eleventh part of the document is a list of glossary terms. These define the key concepts and terminology used in the study to ensure that all readers have a clear understanding of the subject matter.

