

# 高温合金锻件超声波检测显示信号分析

## Analysis of the Ultrasonic Inspection Signals in High Temperature Alloy Forged Pieces

安大锻造厂 王志明

Wang Zhiming (Anda Forging plant)

**[摘要]** 根据超声波形变化的静态和动态特征与缺陷分布状况,结合被检工件的加工工艺,综合评估分析了长期积累的高温合金锻件超声波检测显示信号的特点和规律,为无损检测质量评定可靠性提供了参考依据。

**关键词:** 高温合金 超声波 信号分析

**[Abstract]** The dynamic and static characteristic of the ultrasonic waveform, the distribution of defects in forged pieces and the process of inspected piece had been synthetically reviewed. The Characteristic and low of Ultrasonic signals reflacted from the forged pieces had been summarized. It is a reference basis that is been provide for the reliability of a quality evaluation with NDT.

**Keywords:** high temperature alloy ultrasonic wave signal analysis

### 1 前言

高温合金在航空工业领域应用十分广泛。高温合金的显微组织一般为奥氏体,它的晶粒较为粗大且不均匀。另外,由于高温合金的强化方法(如晶界强化、沉淀强化等)决定了被检材料的声学特性(声速的各向异性及传声特性),导致材料在超声波检测中出现草状回波显示,造成探伤结果误判或掩盖严重缺陷。草状回波的存在有别于材料中夹渣、偏析、碳化物聚集、裂纹、孔洞、过热、过烧、粗晶等缺陷的回波显示,检测时应予以区分。

显示信号的分析是个很复杂的问题。现今应用于现场的A型脉冲式超声波探伤仪,只能提供显示信号的时间和幅度两类信息,探伤人员根据此二信息判断显示信号的性质显然会有困难。本文通过长期经验积累和试验,结合工件的加工工艺、显示信号的特性、波形和底波情况综合分析,评估出显示信号性质,为产品质量结果评定的可靠性和改进锻造工艺提供了一定的参考依据。

### 2 显示信号特点和规律

#### 2.1 草状、粗晶显示信号

回波是以有限的单个不等幅波形显示,与探头位置

及探头型号有关。草状波在示波屏时间基线显示是均匀分布的,它的静态波形重叠性差。几何形状简单工件的粗晶波显示,一般在始波、底波附近或中心区域有一定体积(探伤面和时间基线上综合体现),它的位置重复性好,不可能有较高的回波。草状、粗晶的动、静态波形见图1。

#### 2.2 过热、过烧显示信号

显示回波是有限单峰,且不等幅、幅度较高。回波的起伏较快,并且与探伤位置相关。探头型号变化,波形幅度变化较小,底波损失较大。一般显示信号分布在整个时间基线上。在几何形状简单的工件上有时出现在中心区域。动、静态波形见图2。

#### 2.3 偏析、碳化物聚集、应变线、夹渣显示信号

夹渣、碳化物聚集回波以单峰显示,点、条或零星状分布。波的起伏较快,重复性好。信号出现位置随机性很强。偏析、应变线回波显示信号以单峰或多峰显示。波的幅度较低,有时在工件中的相应点连线为一定的几何形状,如方形、圆形等。其动、静态波形见图3。

#### 2.4 裂纹、孔洞显示信号

回波以单峰或多峰显示,长条形分布。波的重复性好,起伏快,信号十分敏感,反射强度高,有一定面积或体积,易产生应力集中部位,对底波有明显的吸收。静态波形为多峰或根部带有小波。动、静态波形见图4。

的多少能起在保証其微殘生  
的勻性。(如圖表表明晶材料的不  
不均勻的組織晶粒粗細不均  
突然變化的現象說明材料在生  
加熱溫度變異範圍內以慢和  
與快兩種溫度條件的加熱,其結  
果產生(數量)極微細的晶粒  
度,這說明材料在加熱溫度範圍  
域,形變極小,溫度用示在右圖  
燒 溫度下,嚴重變形生過熱或過  
熱,其材料組織晶粒粗細不均

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods used to collect and analyze data. It includes a detailed description of the sampling process and the statistical techniques employed to interpret the results.

3. The third part of the document presents the findings of the study. It shows that there is a significant correlation between the variables being studied, which supports the hypothesis that was tested.

4. The fourth part of the document discusses the implications of the findings for future research and practice. It suggests that the results could be used to inform policy decisions and to guide the development of new programs and initiatives.

5. The fifth part of the document provides a conclusion and a summary of the key points. It reiterates the importance of the study and the need for further research in this area.

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.

7. The seventh part of the document contains a list of appendices, which include additional data and information that is not included in the main text of the document.

8. The eighth part of the document is a list of figures and tables, which provide a visual representation of the data and the results of the analysis.

9. The ninth part of the document is a list of footnotes, which provide additional information and clarification for the reader.

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把材料的情况,本数据多,过评估的  
均匀显微组织。图0.8 $\times$ 晶粒尺寸不主  
的,除了解耦,在铁合金显示信号  
和散射的叠加的团,而迴波反身  
中仅供参考。

要是反瓣波所在层的灵敏度主

响不大,探头的型号,底波回波量  
参考文

。失主要是散射衰减所引起<sup>[2]</sup>

渣,裂纹硫化物夹杂,是缺陷,夹  
西北主0.1%杂质,杂质,杂质,杂质,  
材料,石漆,漆,漆,漆,漆,漆,漆,  
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