Two-dimensional Green’s function, for a line heat source acting on the surface of a coated isotropic thermoelastic material, is investigated in this paper to improve the understanding of interface mechanisms of coating/substrate system. The coating and substrate are modeled as infinite layer and semi-infinite substrate respectively. They are perfectly bonded or are in smooth contact at the interface. Based on the two-dimensional general solution of isotropic thermoelastic materials expressed by harmonic functions, the corresponding harmonic functions with undetermined constants for coating and semi-infinite substrate are constructed, respectively. The thermoelastic field can be obtained by substituting the harmonic function into the general solution. The constants can be determined by the free surface boundary conditions and interface continuous conditions between the coating and the semi-infinite substrate. Numerical results are exhibited in the form of contours and some valuable conclusions for interface effect, interface shear debonding and coating tensile failure are presented.

Introduction

Coated materials have been widely applied in modern engineering [1–6]. The strength evaluation of such materials is based on the interfacial stresses for evaluating the cohesive strength [7–9]. However, because of thin coating and the discontinuous interface effect of some stress components in the interface, it is hard to obtain the solutions, especially those near the interface [10,11].

Green’s functions or fundamental solutions play an important role in both applied and theoretic studies on the physics of materials. They are the foundations for lots of further works. For example, the Green’s functions for a point loading on the surface of a coated material can be used to construct the analytical solutions of practical problems when an arbitrary loading is imposed. In addition, they are essential in the boundary element method as well as the study of cracks, defects, and inclusions on the interfaces.

For the elastic problems, Luco and Apsel [12], Apsel and Luco [13] study the three-dimensional dynamic Green’s functions for an isotropic layered material based on the numerical evaluation of Hankel integral transform. Pan [14] presented the three-dimensional static Green’s functions for the isotropic and transversely isotropic layered material in terms of infinite integrals involving Bessel functions by the propagator matrix method. Rahman and Newaz [15] considered...
Magnetorheological elastomer vibration isolation of tunable three-dimensional locally resonant acoustic metamaterial

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ABSTRACT

Magnetorheological elastomers (MREs) are used as cladding in three-dimensional locally resonant acoustic metamaterial (LRAM) cores. The metamaterial units are combined into a vibration isolator. Two types of LRAMs, namely, cubic and spherical kernels, are constructed. The finite element method is used to analyze the elastic band structures, transmittances, and vibration modes of the incident elastic waves. Results show that the central position and width of the LRAM elastic bandgap can be controlled by the application of an external magnetic field; furthermore, they can be adjusted by changing the MRE cladding thickness. These methods contribute to the design of metamaterial MRE vibration isolators.

1. Introduction

Phononic crystals and acoustic metamaterials have acoustic or elastic bandgaps (EBG), which cannot propagate in the forbidden bandgap [1–3]. The mechanism of phononic crystal EBG formation is Bragg scattering. The lattice size is the same order of magnitude as the acoustic wavelength. Thus, the use of phononic crystals to control low-frequency vibration and noise requires a large and bulky structure. Acoustic metamaterials are artificial microstructures with subwavelength sizes that can flexibly regulate and manipulate the propagation of elastic waves with wavelengths that are up to two orders of magnitude higher than the lattice size. The unit size can be small, making acoustic metamaterials feasible for low-frequency noise and vibration control components. Acoustic metamaterials can be processed and designed for microstructure units to achieve superior performance and many application prospects, such as negative refraction and superlensing [5], double negative refraction and reverse Doppler effect [6], zero refractive index and total reflection [7], subwavelength detection [8], seismic shielding [9], and omnidirectional acoustic cloak [10], and more.

LRAMs have a significant advantage in the field of vibration isolation, and researchers have undertaken considerable effort in this direction. Larabi et al. [11] designed a coaxial cylindrical LRAM with multiple layers of soft and hard materials to obtain a local resonant bandgap. Their results showed that if multiple alternating layers were used instead of individual alternating layers, the transmission spikes would be replaced by multiple spikes. Therefore, the multilayered structure was not conducive to the formation of a large bandgap. Bonnet et al. [12] designed cylindrical and spherical composite metamaterials composed of a hard core and cladding and calculated the resonant frequencies in the form of analytical expressions. Their results showed that all resonant frequencies were independent under the ideal model. Additionally, a low resonance frequency could be obtained by optimizing the composition and shape. Wang et al. [13] designed an LRAM with a metal core and a matrix connected with an elastic beam. This LRAM was tunable over a wide frequency range and could use the deformation to open or close the EBGs, which opened the way for an adaptive switch. Yang et al. [14] used a topological optimization method with an effective mass density to maximize the first EBG of an LRAM. Chen et al. [15] proposed a dissipative LRAM composed of multiple layers of viscoelastic continuum. The dissipative LRAM was used to effectively attenuate transient shock waves. A wide range of shock waves could be nearly completely mitigated by sub-wavelength-scale metamaterials. Krushynska et al. [16] compared 2D and 3D double-local models. Their results showed that 3D double-local LRAMs could produce an absolute bandgap. Furthermore, a 3D finite structure was practical.

The study of metamaterials with intelligent materials is important [17–19], and the study of magnetorheological elastomer (MRE) meta-
检索证明

根据委托方提供的论文目录（2018年），经SCI-EXPANDED数据库检索，许振龙（Xu, Zhenlong）发表的论文被《科学引文索引》SCIE收录了1篇（第一作者1篇）。题录如下:

1. Magnetorheological elastomer vibration isolation of tunable three-dimensional locally resonant acoustic metamaterial
   作者：Xu, ZL (Xu, Zhenlong)[1, 2]; Tong, J (Tong, Jie)[1]; Wu, FG (Wu, Fugen)[2]
   SOLID STATE COMMUNICATIONS 卷：271 页：51-55 DOI: 10.1016/j.ssc.2017.12.024 出版年：MAR 2018
   文献类型：Article
   语种：English
   入藏号：W00425845000009
   地址：

特此证明

华南理工大学图书馆
信息咨询部
2018年5月28日
Two square steel columns are arranged in air to form two-dimensional square lattice phononic crystals (PNCs). Two PNCs can be combined into a non-orthogonal 45° heterojunction when the difference in the directional band gaps of the two PNC types is utilized. The finite element method is used to calculate the acoustic band structure, the heterogeneous junction transmission characteristics, acoustic field distribution, and many others. Results show that a non-orthogonal PNC heterojunction can produce a multi-channel unidirectional transmission of acoustic waves. With the square scatterer rotated, the heterojunction can select a frequency band for unidirectional transmission performance. This capability is particularly useful for constructing acoustic diodes with wide-bands and high-efficiency unidirectional transmission characteristics.

Keywords: Phononic crystals; heterojunction; unidirectional transmission; acoustic band structure.

1. Introduction

In recent years, the study of phononic crystals (PNCs) has attracted considerable research attention. PNCs are composed of two or more elastic materials that are arranged cyclically and exhibit an acoustic band gap (ABG), self-collimation effect,
检索证明

根据委托方提供的论文目录（2018年），经SCI-EXPANDED数据库检索，许振龙（Xu, Zhenlong）发表的论文被《科学引文索引》SCIE收录了1篇（第一作者1篇）。题录如下:

1. Multi-channel unidirectional transmission of phononic crystal heterojunction
   作者:Xu, ZL (Xu, Zhenlong)[1,2] ; Tong, J (Tong, Jie)[1] ; Wu, FG (Wu, Fugen)[3]
   MODERN PHYSICS LETTERS B  卷: 32  期: 4  文献号: 1850050  DOI:
   10.1142/S0217984918500501  出版年:  FEB 10 2018
   文献类型:Article
   语种:English
   入藏号: WOS:000424876900011
   地址:

特此证明

华南理工大学图书馆
信息咨询部
2018年5月28日
Anti-carburizing Coating for Resin Sand Casting of Low Carbon Steel Based on Composite Silicate Powder Containing Zirconium

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Abstract. This paper studied the structure and properties of anti-carburizing coating based on composite silicate powder containing zirconium by X-ray diffraction analyzer, thermal expansion tester, digital microscope and other equipment. It is introduced that the application example of the coating in the resin-sand casting of ZG1Cr18Ni9Ti stainless steel impeller. The anti-carburizing effect of the coating on the surface layer of the cast is studied by using direct reading spectrometer and spectrum analyzer. The change of the micro-structure of the coating after casting and cooling is observed by scanning electron microscope. The analysis of anti-carburizing mechanism of the coating is presented. The results indicate that the coating possesses excellent suspension property, brush ability, permeability, levelling property and crack-resistance. The coating exhibits high strength and low gas evolution. Most of the coating could be automatically stripped off flakily when the casting was shaken out. The casting possesses excellent surface finish and anti-metal penetration effect. The carburizing layer thickness of the stainless steel impeller casting with respect to allowable upper limit of carbon content is about 1mm and maximum carburizing rate is 23.6%. The anti-carburizing effect of casting surface is greatly improved than that of zircon powder coating whose maximum carburizing rate is 67.9% and the carburizing layer thickness with respect to allowable upper limit of carbon content is greater than 2mm. The composite silicate powder containing zirconium coating substantially reduces the zircon powder which is expensive and radioactive and mainly dependent on imports. The coating can be used instead of pure zircon powder coating to effectively prevent metal-penetration and carburizing of resin-sand-casting surface of low carbon steel, significantly improve the foundry production environment and reduce the production costs.

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Simulation Calculation and Test Verification of Hydraulic Retarder Based on Turbulence Model of SST–Kω

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Abstract: In order to improve the accuracy of traditional turbulence simulation calculation models of hydraulic retarder, the improved two-equation turbulence model of SST–Kω is used to numerically simulate the turbulent flow of hydraulic retarder as the research object named THE-4C, under different filling ratio and different velocity with gas-liquid two-phase whole flow in the CFX14.5, aimed at the flow characteristics of strong rotation, multi wall and large curvature. The simulation results of braking torque showed that the torque increased as the velocity increased when the filling ratio was 95%, decreased as the velocity increased when the filling ratio was 80%. This was consistent with the results of the bench test, the maximum error between computer fluid dynamics (CFD) and bench test was 3.6%. Compared with the traditional turbulence models, the precision of improved SST–Kω turbulence model was raised about 20%, and the running time was saved by nearly 50%, which means that the turbulence model of improved SST–Kω is more suitable for simulating turbulent flow of hydraulic retarder. The research results provide an accurate and highly efficient reference calculation model of CFD to deeply study the breaking mechanism of hydraulic retarder.

Keywords: Hydraulic retarder; Turbulent flow; SST–Kω; Numerical simulation calculation; Braking torque

0 前言

液力缓速器是汽车缓速辅助制动装置之一, 与电液缓速器相比, 具有制动扭矩大、冲击均缓、不存在衰退等优点, 在中大型多功能车辆中得到了广泛应用[1]。其缓速过程具有非线性、多变量和高对称性等特点[2], 涉及循环状态、循环、叶片形状、叶片角度等多个复杂几维参数和动态一静态合作、递增减缩、流量分离、转流流动等多种以上的复杂流动现象[3], 是雷诺数大于 108 的湍流流动[4]。

这些对数增加了液力缓速器流场分析难度, 且液力缓速器工作在两相流相共存的状态, 使得常规流场分析方法在液力缓速器设计工况下取得符合实际的计算结果。

近年针对液力缓速器流场现象的 CFD 计算常用尺度解析模拟和雷诺时均模拟方法[5]。大涡模拟(LES)是尺度解析模拟常用的湍流模型, 该模型对流场计算
汽车用 6063 铝合金硬质阳极氧化工艺的研究

Investigation on Hard Anodic Oxidation Technology of 6063 Aluminum Alloy for Automobile

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2. 广东省金属材料与先进制造技术重点实验室，广东 珠海 519090）

Abstract: 使用硬质阳极氧化工艺对汽车用 6063 铝合金进行阳极氧化处理。通过实验发现，电流密度影响氧化膜的形成过程。氧化初期，提高电流密度有利于促进成膜过程，获得性能较好的氧化膜。当电流密度大于 2.0 A/dm² 时，氧化膜的溶解速率加快，表面孔径增大，使得氧化膜的硬度和耐蚀性有所下降。

Key words: 6063 铝合金；硬质阳极氧化；耐蚀

1 实验

1.1 铝合金硬质阳极氧化工艺配方

<table>
<thead>
<tr>
<th>质量分数 (%)</th>
<th>体积分数 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>98%</td>
<td>100%</td>
</tr>
</tbody>
</table>

1.2 实验方法

配制 5.5 氢氧化钠溶液，阳极使用尺寸为 10 cm×10 cm 的 6063 铝合金板材，阴极使用尺寸为 20 cm×20 cm 的不锈钢。然后在 150 ℃下将 6063 铝合金板材进行阳极氧化处理，采用油压机打底——碱腐蚀——水洗——待干。
基于故障树的电喷发动机急速不稳分析研究

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摘要：发动机急速不稳是电喷发动机工作中经常遇到的故障现象。本文采用故障树分析方法对发动机急速不稳故障进行分析，建立了急速不稳故障树，并分析了急速不稳故障的形成机理和影响因素。通过对急速不稳故障树的分析，找出急速不稳故障的主要原因。针对急速不稳故障，提出了相应的故障诊断及排除方法。

关键词：电喷发动机，急速不稳，故障树，故障诊断

中部分类号：TP277.4 文献标识码：A 文章编号：1001-5062（2016）03-0015-06

发动机急速不稳是指发动机在怠速运转时，由于发动机控制系统失灵或传感器信号错误等原因，导致发动机的转速不能稳定在规定范围内，而引起的发动机转速波动现象。

在故障诊断中，基于知识的诊断方法具有良好的自学习优点，但是由于系统知识更新困难，该方法难以推广使用。基于解析图的诊断方法是一种基于图示性的诊断和故障诊断的；在无故障故障生成和设备故障诊断存在的不确定关系，容易造成故障图中的故障树，故障树分析是一种应用较广泛，对于复杂系统的关键性和安全性进行预测的方法，在发动机急速不稳故障诊断中采用故障图分析法，通过分析急速不稳故障的形成机理和影响因素，找出急速不稳故障的主要原因。针对急速不稳故障，提出了相应的故障诊断及排除方法。

1 故障树诊断原理

1.1 故障树分析方法

故障图分析方法（FTA）是一种应用于复杂系统安全性与可靠性分析的方法，也是目前国内外公认的系统可靠性分析的重要方法。它以系统中出现的故障事件（顶事件）为分析目标，应用逻辑演绎研究顶事件发生的各种直接与间接原因。它用一定的符号（逻辑门）表示系统中事件的相互关联，输出零级门故障与系统故障之间的逻辑关系。对故障图进行定性分析，可求出各事件发生的概率及其它量的标度，而最低的环节，对故障图进行定量分析，可求出故障图发生的概率及其概率的分布。

采用故障图分析方法，顶事件发生或顶事件不发生时，系统处于正常运行状态，同时，系统中各部件或子系统故障概率为顶事件发生或不发生时的条件概率，作为系统中事件状态的概率，顶事件状态用变量表示，顶事件不发生为事件，顶事件不发生为事件，顶事件不发生为事件，顶事件不发生为事件，顶事件不发生为事件。顶事件状态可表示为：

$$f(X) = \begin{cases} 1, & \text{当} \bar{x} \text{不发生} \\ 0, & \text{当} \bar{x} \text{发生} \\ \end{cases}$$ (3)
Research on effects of bias magnetic field on performance of spin-valve sensor

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Abstract: Effects of perpendicular bias magnetic fields on hysteresis, non-linearity and sensitivity of spin-valve sensors are investigated by testing the magnetic response (MR) curves while perpendicularly apply bias magnetic field to sensitive axis. It is found that the hysteresis, non-linearity and sensitivity all decrease with increasing bias field, and sensitivity is inversely proportional to the bias field. The research results can offer the theoretical support for application of spin valve sensors.

Key words: spin valve sensor; bias magnetic field; magnetic hysteresis; sensitivity

0 引言

自1991年自旋阀传感器被发现以来，已受到了广泛关注。由于其具有低电能耗效、高线性度、易于与硅基半导体电路集成等优点，已成功应用于磁传感器的集成[1, 2]，计算机硬盘读头[3, 4]，磁电信号隔离器[5-8]及电子罗盘[9, 10]等。在一些应用场合，如电子罗盘中，偏置磁场的方向并不一定沿自旋阀传感器的敏感轴。此时，偏置磁场垂直于敏感轴方向的分量将会起到一个偏置磁场的作用，对传感器的性能造成一定程度的影响。本文利用基于二维单轴霍尔线圈的磁传感器测试系统，测试了自旋阀传感器在不同偏置磁场下的磁响应曲线，并根据测得的磁响应曲线分析了偏置磁场对性能参数的影响。

1 实验

自旋阀传感器可透过一系列类似于半导体集成电路的工艺进行制备[8, 11]，其基本结构电路图如图1所示。自旋阀传感器的基本结构为4个自旋阀电阻条组成的惠斯通电桥，其中一个对角上的2个电阻器R1, R2的各极方向与另一个对角上的2个电阻器R3, R4相反。因此，在信号磁场的作用下，R1和R3的电阻会将变化△R而R2和R4的电阻值将变化−△R, 从而使整个电桥失调形成一个正比于信号磁场的电压输出。

图1 自旋阀传感器电路结构示意

图2 为实验所用的二维自旋阀传感器线圈，图2中自旋阀传感器的敏感轴沿其中一端，该端与敏感轴平行的线圈可
本文借助Ansys15.0数值模拟软件，通过建立二维非线性有限元模型，模拟分析了A-95/4J33可伐合金钎焊接头应力场，得出了A-95/4J33可伐合金钎焊接头的残余应力分布区域及大小，从而根据数值分析情况对焊接试验进行指导。

1 数值模拟分析

焊接冶金过程的实质是金属在焊接条件下经历加热、熔化和冷却凝固的过程，涉及到热传导过程、焊接区金属的相变过程以及温度变化所引起的应力过程等众多的物理、化学过程。而钎焊属于固相连接，钎焊时母材不熔化，通过熔化温度比母材低的钎料。...
Anti–carburizing Coating for Resin Sand Casting of Low Carbon Steel Based on Composite Silicate Powder Containing Zirconium

FENG Shengshan1,2, XIE Shuzhong1,2, ZHAN Chunyi1,2, LIU Chunjing2, GAO Yunhua1, LIANG Jiahao3

Abstract: The structure and properties of composite silicate powder containing zirconium were investigated by X-ray diffraction analyzer, thermal expansion tester, digital microscope and other equipment. The application example of anti-carburizing coating based on the powder in the resin-sand casting of ZG1Cr18Ni9Ti stainless steel impeller. The anti-carburizing effect of the coating on the surface layer of the cast was studied by direct-reading spectrometer and spectrum analyzer. The change of the micro-structure of the coating after casting and cooling was observed by scanning electron microscope. The analysis of anti-carburizing mechanism of the coating was presented. The results show that the coating possess excellent suspension property, brush ability, permeability, leveling property and crack-resistance. The coating exhibits high strength and low gas evolution. Most of the coating could be automatically stripped off flakily when the casting is shaken out. Containing zirconium compound silicate mineral powder coatings can take place of pure zircon powder coating, effectively prevent the mild steel resin sand casting surface adhering sand and carburizing, significantly improve the casting production environment, reducing the casting cost of production.

Key words: zirconium-containing silicate; low carbon steel; resin sand; anti-carburizing; coating
Study on Laser Welding of Dissimilar Metal Materials Used in Automobile Bodies

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Abstract: The laser lap-welding experiment is carried out with steel plate ST07Z and aluminum alloy 5052. The weld pool geometry distribution is obtained by using MATLAB software. Then welding process parameters are optimized. The welding joint microstructure, fracture morphology and mechanical properties are analyzed with the metallographic microscope and scanning electron microscopy. The results show that the weld is ideal without obvious defects such as porosity, crack etc. Step areas appear in the joint area and there is obvious dividing line between dissimilar metal materials. The interface bonding relies on the liquid aluminum on the wetting filling and spreading of steel surface. The Average welding joint shear strength is 27.90 MPa and the fracture morphology of welding joint is a quasi-cleavage and ductile mixing mode.

Keywords: automotive dissimilar metals; laser welding; fracture morphology; mechanical property; weld pool
Study on topology of bi-directional DC/DC converter for hybrid energy storage system

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Abstract: The bi-directional DC/DC converter is one of the very important part of hybrid energy storage system, especially in large power vehicle hybrid power supply system transformation under the condition of bidirectional DC/DC converter with high switching frequency, loss and topology control is more complex. In order to solve this problem, an energy management strategy for hybrid power system combining with the ESMP full bridge bidirectional DC/DC converter topology building an experimental environment based on full bridge topology oriented hybrid energy storage system with bidirectional DC/DC converter, experimental results show that the topological structure of small loss and redundancy control improve the feasibility of the system and the efficiency of the energy convert.

Keywords: bi-directional DC/DC converter, hybrid energy storage system, switching frequency, active full bridge, redundancy control

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