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高真空用歯車のトライボ性能評価

Tribological Evaluation of Surface Modified Gear in Vacuum

粒子分散複合めっきローラの摩擦・摩耗

Friction and Wear of Dispersed Particle Multiplex Plated Rollers

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Scuffing and Pitting of Wear Resisting Steel Gears

複合表面処理歯車の面圧強さと動的性能

Surface Durability and Dynamic Performance of Multiplex Surface Treated Gears

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面圧強さに及ぼすローラ形状の影響

Effect of Cross Section Profile on Surface Durability of Rollers

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Surface Durability and Dynamic Performance of Forged Sintered Powder Metal Gears

多孔質ファインセラミックス製静圧ガイドに関する研究  
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トラクションドライブに関する研究  
A Study on Traction Drive

＊ ＊ 研究報告 ＊ ＊ ( 6 件 )

Tribological Performance of Electroless Ni Alloy Plated Stainless Steel Gears in High Vacuum  
Akira Yoshida, Masahiro Fujii, Tomoki Harano\* (\*Anan National College of Technology)  
VDI International Conference on Gears VDI-Berichte Nr. 1665, pp.967-979, March 2002

Spur gear test was carried out under non-lubricating condition in high vacuum of the order of  $10^{-4}$  Pa at room temperature to investigate the wear and friction performances of electroless Ni alloy platings. Three kinds of electroless Ni alloy platings; electroless Ni-P alloy plating, electroless Ni-B alloy plating and electroless Ni-P-B alloy plating, and two kinds of composite platings; electroless Ni-P alloy plating with PTFE particles and electroless Ni-P alloy plating with BN particles, were employed. The influences of the composition and the dispersed self-lubricated particles in the electroless Ni alloy platings on the tribological performance were examined. In addition the gear test results were compared with the roller test results obtained under about the same maximum Hertzian pressure.

Application of Wavelet Transform to Health Monitoring and Evaluation of Dynamic Characteristics in Gear Sets

Akira Yoshida, Yuji Ohue\* and Masanori Seki (\*Kagawa University)  
VDI International Conference on Gears VDI-Berichte Nr. 1665, pp.853-865, March 2002

This paper deals with a health monitoring and an evaluation of dynamic characteristics in gear sets. The Wavelet Transform (WT) is a method for the time-frequency analysis. The dynamic characteristics of both steel and sintered gears were measured using a power circulating gear testing machine and were analyzed in a time-frequency domain by the continuous and discrete WTs. Furthermore, the health monitoring of gear sets was carried out and the tooth surface failure by pitting was diagnosed using the WTs. The vibration acceleration of the gear box could be divided to two different behaviors above and below the tooth mesh frequency. A failed tooth could be found out by the change of WT intensity of the vibration acceleration. It could be said that the continuous and discrete wavelet transforms are a useful method for diagnosing the tooth failure and for evaluating the gear dynamics.

Scuffing Characteristics of Wear Resisting Steel and Steel with Surface Modification Treatment  
Kenzo Miura\*, Tetsuo Komoda\*\*, Takashi Kuwata\*\*, Akira Yoshida and Masahiro Fujii (\*Mitsui Testing & Research Center, \*\*Mitsui Engineering & Shipbuilding)  
Bulletin of The Marine Engineering Society in Japan, Vol.30, No.1, pp.43-48, March 2002

Wear resisting steel(WRS), with improved scuffing characteristics, was newly developed in order

to be applied to the frictional parts for machinery. The two rollers tests were carried out using the newly developed WRS, steels with Ni-P electroless plating, and with electrolyzed and sulfurizing treatment. Then the scuffing characteristics of these materials were discussed.

The anti-scuffing characteristics of WRS were very good and the frictional coefficient was as small as about (1/3) of SUJ2, a reference material. From the test results using WRS specimen of two kinds of hardness, the anti-scuffing characteristics of specimen of which the hardness was low were higher. The anti-scuffing characteristics of steel with Ni-P electroless plating were good. Part of Ni-P electroless plating layer remained during the test period but the other part of plating layer disappeared. On the other hand, the electrolyzed and sulfurizing layer which is effective for running-in, disappeared in a short time, and the characteristics became that of base material.

As the result of observation of surface and cross section of specimen, the white layer on the scuffing surface was found from 30 to 50 $\mu$ m thickness. It seemed that the layer is a martensite including supersaturatedly solidified carbon which is a part of cementite at the sub-surface dissolved by thermal and mechanical energies.

プラズマ浸炭硬化粉末焼結ローラの面圧強さに及ぼすショットピーニングの影響（ショット投射速度，ショット粒径およびショット硬さの影響）

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日本機械学会論文集（C編），68巻668号，1265頁～1272頁，2002年4月

ショットピーニング加工を施したプラズマ浸炭硬化粉末焼結ローラを試験ローラとして，二円筒滑り転がり接触条件下で疲れ試験を行い，ショットピーニング条件とローラの面圧強さとの関係について検討した．ショットピーニングによりローラ表面付近の硬さと圧縮残留応力が増大したが，ローラ内部の気孔がつぶれ，表面粗さが増加した．疲れ試験による試験ローラの損傷はスポーリング損傷であり，気孔がつぶれた位置で損傷が発生したが，弱いショットピーニングを施したローラの面圧強さは向上した．さらに硬さに対する両振りの直交せん断応力の比の振幅値が最大となるローラ円周面からの深さと損傷深さとがほぼ一致していることを示した．

Evaluation of the Fatigue Life of a Sintered Machine Element under the Sliding/Rolling Contact Condition based on Fracture Mechanics

Akira Yoshida, Yuji Ohue\* and Hiroshi Ishikawa\*（\*Kagawa University）

Journal of Strain Analysis for Engineering Design, Vol.37, No.4, pp.327-336, July 2002

In order to evaluate the surface durability of sintered machine elements, the fatigue lives of 28 kinds of sintered roller under a sliding/rolling contact condition were estimated using Paris's law based on linear fracture mechanics. The fatigue tests were conducted using a two-Cylinder testing machine. The stress intensity factor for the mode II under the Herzian contact condition was calculated using the finite element mode. The value of the stress intensity factor became larger as the crack length became longer to the contact surface, and the value of the stress intensity factor range was independent of the crack angle. It could be clarified that the fatigue lives of the sintered rollers depended on the pore diameter and the hardness. It was obvious that the pore distribution has to be taken into consideration to estimate the fatigue lives of the sintered rollers more precisely.

Influence of Soft Surface Modification on Rolling Contact Fatigue Strength of Machine Element

Akira Yoshida, Masahiro Fujii

Tribology International, Vol.35, Issue 12, pp 837-847, December 2002

Various surface modification methods have been employed in order to improve the tribological performance of machine elements. In this work, electroless Ni-P alloy plating and sulfurizing treatments were employed, and the surface modified steel rollers and ball bearings were fatigue-tested under a pure or free rolling contact condition. The fatigue lives of both rollers and bearings were improved by these surface modifications. The contact pressure and subsurface stresses of the surface modified rollers and bearings were analysed. The reason why the rolling fatigue strengths of surface modified rollers and bearings were higher than those of the non-coated ones would be due to the smaller contact pressure and the smaller subsurface stresses by the smaller elasticity as well as the conformity of the plated layer.

#### \*\* 総説・解説 \*\* (2件)

無潤滑，真空下における歯車の摩擦・摩耗・動力損失

吉田 彰

日本機械学会歯車装置の次世代設計・製造技術調査研究分科会研究報告書，197頁-200頁，2002年12月

無潤滑および真空下における歯車の効率に関連する摩擦・摩耗・動力損失に関して，おもに材料，表面改質の観点より，最近の国内外の研究成果を基に解説した．

歯車の強度・寿命に関する研究展望

吉田 彰

日本機械学会歯車装置の次世代設計・製造技術調査研究分科会研究報告書，212頁，2002年12月

今日の社会における省エネルギー化，低環境負荷化，産業界における高コストパフォーマンス化のすう勢の下，歯車の強度・寿命に関する研究展望と期待について記述した．

#### \*\* 学術講演 \*\* (16件)

吉田 彰，藤井正浩，原野智哉\*，布野靖明 (\*阿南高専)

高真空下における表面改質歯車の歯面摩耗評価

日本機械学会中国四国支部第40期総会・講演会講演論文集，No.025-1，講演番号1104  
361頁-362頁 2002.3.5

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吉田 彰，藤井正浩，小林 寛，三浦健蔵\* (\*三造試験C)

耐摩耗性ステンレス鋼の摩擦・摩耗特性

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浸炭硬化鋼製ローラの面圧強さに及ぼすショットピーニングの影響

日本機械学会中国四国支部第 40 期総会・講演会講演論文集, No.025-1, 講演番号 1107, 367-368 頁  
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粉末焼結歯車の面圧強さに及ぼすショットピーニングの影響

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吉田 彰, 大上祐司\*, 關 正憲, 川村 巧 (\*香川大学)

ショットピーニング浸炭硬化鋼製歯車の面圧強さと動的性能

日本機械学会中国四国支部第 40 期総会・講演会講演論文集, No.025-1, 講演番号 1110, 373-374 頁  
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Application of Wavelet Transform to Health Monitoring and Evaluation of Dynamic Characteristics in Gear Sets

VDI International Conference on Gears, Munich, VDI-BERICHTE NR. 1665, pp.853-865  
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Akira Yoshida, Masahiro Fujii, Tomoki Harano\* (\*Anan National College of Technology)

Tribological Performance of Electroless Ni Alloy Plated Stainless Steel Gears in High Vacuum

VDI International Conference on Gears, Munich, VDI-BERICHTE NR. 1665, pp.967-979  
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吉田 彰, 藤井正浩

粒子分散複合めっきの真空中トライボ性能

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鋼製ローラと粉末焼結ローラの面圧強さに及ぼすショットピーニングの影響

ショットピーニング技術, 第 14 巻第 2 号, 講演論文 6, 12-13 頁 2002.5.14

吉田 彰, 大上祐司\* (\*香川大学)

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