6th International Conference and Exhibition on

Automobile & Mechanical Engineering

July 08-09, 2019 | Zurich, Switzerland

Posters

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Friction effect of chromium carbon nitride coating on engine cylinder liner surface

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The automotive industry is under great pressure to meet the legislative demands for producing environmentally friendly vehicles with reduced resource utilisation as well as to satisfy customer demands. In terms of improving the performance of the engine components and forming very demanding, high strength materials, the contact surfaces must show reduced friction, anti-adhesive properties and increased wear resistance. Therefore, the automotive, tool and forming industries are keenly interested in various surface-engineering techniques, especially hard physical vapour deposition (PVD) coatings. The motivation for the choice of hard coatings is mainly based on their superior mechanical properties, such as high hardness and excellent galling and wear resistance.Chromium Carbon Nitride (CrCN) Coating is deposited with PVD method by KAPCO Coating Industry and Trade ltd. Simulation and measurement of friction and wear were conducted using a reciprocating tribometer. The tribometer tests were carried out with 1st piston ring rubbing on uncoated and CrCN coated cylinder liner using 5w40 synthetic engine oil, under boundary lubrication conditions. The liner material is a spheroidal graphite cast iron. Surface analysis was performed using a 3D digital optical microscope, Scanning Electron Microscope (SEM)/X-Ray and 2D-3D roughness profilometer. Chromium (Cr) from CrCN coating is well detected on the surface and it is found mixed with other elements of additives protecting the surface under boundary lubrication conditions. The results indicated that CrCN protected the cylinder liner worn the piston ring surface. Although the CrCN coating eliminated the wear of the coated liner, the restricted tribofilm formation and the high coating hardness led to more intense wear of the piston ring. CrCN coating showed slightly higher friction value between piston ring and coated cylinder liner pairs related non-coated liner.At the end of the tests, while abrasive wear lines-grooves occured on the rubbed surface of non coated liner, a good protection of wide hills with full of the asperities (of the honed surface) formed on the wear track of CrCN coated cylinder liner which protected the surface.

Biography

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3D digital microscopic examination of graphene coated engine cylinder liner surface

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Fuel combustion in automobile engines causes gaseous emissions, which in turn causes damage to the environment when automobile production increases. This can be solved by increasing the efficiency of the engine, and as the efficiency increases, fuel consumption is reduced. An engine cylinder liner is affected high-temperature and high-pressure gas and always cause high-speed slide friction with piston rings and piston skirt. If liner surfaces are properly configured, tribological behavior can be achieved. Functional surface treatments and coatings provide to improve the sliding properties of metal surfaces. The inner walls of the cylinder must be able to withstand higher combustion pressure and higher piston speed, so that the surface of the cylinder must be resistant to friction and abrasion. Nowadays, it is desired to obtain the most efficient surface by applying different coatings to these surfaces. A lot of different types of Nano-coatings are used for this process. Nowadays, nano coatings are preferred because they are more advantageous than conventional coatings. In this study, the diesel engine cylinder liner is coated with graphene using chemical vapour deposition (CVD) technique on the small cut-pieces of cylinder liner surface. The graphene coating was successfully deposited on cylinder liner as monolayer, by direct synthesized CVD method under vacuum conditions using hydrogen flux synthesizing with hexane vapor in new design CVD reactor. This coating rights belongs to GrafenBioTech Nanotechnology engineering Ltd. in Konya-Turkey. Friction properties of (CVD) graphene coated liner were tested experimentally in tribotest rig. The tribometer tests were carried out 100CrMn6 balls rubbing on coated and uncoated cylinder liners using 5w40 synthetic engine oil, under boundary lubrication conditions. The coated liner material is a spheroidal graphite cast iron. 2D and 3D micrographs, 2D and 3D surface roughness parameters were presented. Graphene coating showed slightly lower friction value between ball and coated cylinder liner pairs related non-coated liner. No wear exist on the ball surface while abrasive wear lines-grooves occured on the rubbed surface of non coated and coated liner (with protective layers).

Biography

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New engine technology air sealing

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The new technology uses air sealing in lieu of conventional mechanical sealing, and is designed for (a) Horizontally-Opposed/Scotch-Yoke (H-O/S-Y) piston engines, and (b) Twin-Wedge Oscillating and (true) Rotary engines, where the pistons/ rotors are positively and accurately located, such that they do not touch their mating components, but maintain a tiny clearance between them. It is fully realised that air sealing will not provide a perfect seal, but the technology also recognises that perfect sealing is not required as the higher compression-ratio and induction air-pressure compensates for the (small amount of) by-pass gases. The technology is designed to permit lighter, lower, quieter reduced-cost and more-compact engines. Using air-sealing, there is virtually no friction between the primary mating components, with no lubrication required, no wear, and thus provides an ultra-long service life. It uses a labyrinth of grooves, which are skilfully-designed to most-efficiently generate extremely high-speed eddy currents of the air, so as to provide effective sealing. Advantages of air-sealing include: providing a pressurised stratified-charge air-fuel mixture for improved combustion; providing an effective after-burn; providing higher fuel economy and higher (thermal, mechanical and volumetric) efficiencies; providing significantly lower friction; allowing for a liquid and air "minimal-cooling" system; continually cleaning internal components, especially spark-plugs and fuel injectors; significantly reducing all four harmful emissions; and requiring a less-powerful (air-operated) starter motor; A turbo-charger or super-charger, and a standard electronic fuel-injection system, are used. While conventional cylinder-heads and poppet valves can be used with H-O / S-Y piston engines, the overall performance is further enhanced by the use of rotary inlet-only valves. The inlet valves have only (relatively) cool air, rather than extremely hot exhaust gas, passing through them; hence the severe problems of sealing-efficiency, lubrication, and excessive wear with rotary exhaust valves are eliminated.

Biography

After graduating in Australia in 1966, Colin commenced his automotive engineering career, specialising in engine design and development, high-performance, emissions, and alternative fuels. After two years, he was awarded a scholarship to continue his engineering education and work experience at a major automotive research centre in the U.S.

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Modeling of multi-objective robust design approach to passive vehicle suspension system

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In product development, the design is a multi-objective decision-making process. Various approaches, including weighted single objective optimization, multi-objective optimization, robust design with single decision metrics, have been formulated and applied to different design problems. The aim of this study is to minimize the acceleration of the vehicle body and relative displacement between the vehicle and suspension components with the integration of robustness and durability at the design stage. Evaluation of 1-DOF (simple) vehicle suspension system is the first step to evaluate the multi-degree of freedom suspension models. Then, the simple passive suspension model is investigated by using multi-objective robust design approach. In this research, multi-objective robust design approaches are modeled and applied to a passive vehicle suspension system and are compared to other existing approaches.

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Tyre cavity design for better fuel economy

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Rolling resistance is one of the central areas of focus in the on-going tyre developments and research. This is because of the considerable impact it holds on vehicle's fuel economy and CO_2 emissions on a global scale. However, reducing rolling resistance is not an easy task to do due to the complexity of tyre construction and the trade-offs involved between tyre's main characteristics in the process. A prospective solution that may help in greatly minimising the trade-offs and improve fuel economy is the notion of mutliple compartments tyre. This presentation explores the potentiality of mutli-compartments tyre solution in lowering rolling resistance with minimum trade-offs possible. In this respect, several novel tyre designs were introduced and investigated via Abaqus/Explicit for rolling resistance, grip, ride comfort and cornering. The investigation revealed a clear difference in tyre peformance between the multi-compartment designs and the conventional tyre.

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Aldehyde and ketone emission characteristics according to operating conditions of diesel engine using blended diesel fuel with hydrated n-butanol

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The objectives of this study is to investigate the emission characteristics, especially, aldehyde and ketone, from a single-diesel engine when using diesel, butanol, and water mixture. Characteristics of combustion and exhaust emission of blended fuels (Diesel+Butanol+Water) are compared with the results of the neat diesel according to operating conditons of the engine. The blended fuels are set of two groups (D10B2W and D10B5W). Both fuels have 10 wt% of butanol and each with 2 wt% and 5 wt% of water. Blending n-butanol and water with diesel holds the purpose of simultaneously reduce both particle matter (PM) and oxidizes of nitrogen (NOX) from the diesel engine. Four aldehydes (formaldehyde, acetaldehyde, acrolein, propionaldehyde) and one ketone (acetone) are mainly measured by DNPH-HPLC method. Engine operating conditons were two engine speed, one fixed injection quantity, and 4 different injection timings. For the aldehydes and ketone results, by adding alcohol fuel to the diesel have increased the amount of the carbonyl compounds than neat diesel. Also increasing the water amount leads to having more carbonyl compounds. Aldehydes and ketone tend to be produced more at low combustion temperature and when reaction time is short. NOX was clearly reduced at 900 rpm and this is enhanced when the content of water increased. But NOX reduction at 1900 rpm was minor from both blended fuels. At most of the engine operating conditions, the diameter of the PM(particulate matter) has reduced than neat diesel. But at the one of the engine operating condition, when using D10B5W fuel, the diameter of the PM have exceeded the neat diesel case resulting increased mass of PM.

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Comparison of hydrocaron components affecting de-nox performance of hc-selective catalytic reduction catalysts

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The catalytic performance of copper (Cu)-containing zeolite catalysts supported on various types of zeolites (chabaziete, MFI, and BEA frameworks) was investigated in the hydrocarbon (HC)-selective catalytic reduction (SCR) of NOx with C_3H_6 and n-C_4H_{10} as reducing agents. The catalysts were prepared by an wetness incipient impregantion method with varying copper loadings from 1 to 10 wt%, thereafter they were washcoated on the commericial monolitic honeycomb substrate. All the prepared powder catalytst were characterized by N_2 adsorption isotherms, powder X-ray diffraction (XRD), inductively coupled plasma–atomic emission spectrometry, solid-state^{27}Al magic angle spinning–nuclear magnetic resonance, ultraviolet–visible spectroscopy, X-ray photoelectron spectroscopy, field emission scanning electron microscopy, and high-resolution scanning electron microscopy. The impregnation of Cu to the respective zeolites did not modify the inherent zeolite topology, whereas the loading levels of copper and zeolite topology significantly affected the de-NOx performance of Cu/zeolites. Among the Cu/zeolite catalysts, 2Cu/ZSM-5 showed the best catalytic performance both the C3H6- and C_4H_{10}-SCR, exhibiting a nearly 70% de-NOx performance at 360^{0}C in C_3H_6-SCR and 74% NOx conversion at 450-465^{0}C in C_4H_{10}-SCR, followed by Cu/BETA and Cu/SSZ-13. The effects of coexistent gases (0-8 vol.% oxygen and 0-10 vol.% carbon dioxide) and hydrothermal aging at 700^{0}C were also evaluated. Oxygen was an indispensable component for the HC-SCR process, and its concentration affected the N_2 selectivity and temperature window of the maximum de-NOx performance. The presence of CO_2 in the feed stream was an inhibitor for NOx reduction.

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Trust in automation: An on-road study of trust in advanced driver assistance systems

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Appropriate user trust is critical in ensuring the acceptance and safe use of Advanced Driver Assistance Systems (ADAS). Despite the prevalence of ADAS on-road today, there is a limited understanding of how trust is affected by a user's first contact with the system on-road. Ten participants without prior experience were introduced to a level 2 system and completed an on-road test drive session. Utilizing a mixed-methods approach including the Trust in Automation (TiA) questionnaire, verbal trust scores and Facial Emotion Recognition (FER), trust in the system was measured at key milestones. TiA scores increased in a majority of participants, and a significant shift in the factor Reliability/Competence (p=0.02) was observed post-drive. According to FER scores, participants with a gain in TiA post-drive and those with a loss in TiA post-drive, more frequently displayed the emotions happy and angry, respectively. Results indicate that trust increases after a user's first experience with ADAS and further that FER may be predictive of user trust in automation.

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Daily drivers: The modern day armored passenger vehicles

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After building over 9,500 armored passenger vehicles International Armoring Corporation (IAC) is an expert on the design and manufacture of armored passenger vehicles for military and government applications as well as corporate and private individuals. Having started IAC over 25 years ago under the premise of building the most technologically advanced armored passenger vehicles, IAC continues to advance designs, materials and processes, continually revolutionizing the industry. With a focus on passenger protection, maintaining the original appearance and performance IAC built vehicles are in high demand around the world. With a common sense approach together with a strong focus manufacturing of vehicles for the end users perceived threats. With more than 30 years in the industry author not only has more hands on experience in the industry but numerous stories/experience he can share of the people he has met and the unique experiences (some life threatening) for his time as an owner and operator in this fascinating industry. Many of the experiences shared by author have been learning application to numerous products and industries.

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An integrated approach to low-cycle/thermo mechanical fatigue design for automobile exhaust materials/components

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With stringent environmental regulations and lightweight/fuel economy demands, advanced automobile exhaust system design relies on utilization of materials to its maximum capacity against low- cycle fatigue (LCF) and thermo mechanical fatigue (TMF) failure. Traditionally, characterization of material's LCF/TMF resistance was obtained through extensive testing and correlation, which drives the cost up for design. An integrated creep-fatigue theory (ICFT) has been developed at the National Research Council, Canada, to address constitutive modelling and life prediction, in a self-consistent and unified fashion, based on i) deformation decomposition by participating mechanisms and ii) holistic damage accumulation by nucleation and propagation of surface/subsurface cracks in coalescence with internally distributed damage. Automotive exhaust system materials such as ductile cast iron and austenitic cast steel are used as example materials for demonstration in good agreement with experimental results and metallurgical examinations. This enlightens the understanding of the roles each mechanism plays in LCF/TMF processes, thus helping material and component design specifically targeting the most damaging mechanism(s) encountered in service.

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