Nanofabrication and Functional Materials (NFM) Research Group, Universiti Sains Malaysia, School of Mechanical Engineering, 14300 Nibong Tebal, Seberang Prai Selatan, Pulau Pinang, Malaysia.
Phone: +604 599 6383/ +604 599 6309
Fax: +604 594 1025
Web: nfm.eng.usm.my
Email: nfm@usm.my
Introduction

School of Mechanical Engineering is actively anticipating research in various fields of Mechanical and Manufacturing Engineering. The school especially Nano Fabrication and Functional Materials (NFM) Group in collaboration with Malaysian Tribology Society (MyTribos) proposes to conduct Colloquium for the year 2016 on 16th January 2016.

This colloquium is intended to bring all the researchers and graduates students to share their knowledge in the area of research and development. It is anticipated that the colloquium will also be beneficial for the graduate students to improve their quality of research work.

AIM

To nurture a love of learning and culture of excellent in research and development especially within the School of Mechanical Engineering and generally all universities in Malaysia.

OBJECTIVES

- To intensify the awareness, cognizance and networking between the researchers and graduate students.
- To furnish a platform for presentation of research output in progress.
- To equip the graduate students in scientific and technical communication.
- To promote research activities and patronise publication work.
PATRON
Professor Dr Zainal Alimuddin Zainal Alauddin

PROGRAM COORDINATOR
Dr Ramdziah Md. Nasir

CHAIR PERSON
Dr Khairudin Muhammad

TECHNICAL MEMBERS
Ass. Prof. Dr Jamaluddin Abdullah
Dr Ing. Muhammad Razi Abdul Rahman
Ir. Dr Abdus Samad Mahmod
Ir. Dr Khairudin Muhammad
Dr Loh Wei Ping
Dr Mohd Azmi Ismail
Dr Mohd Yusof Idroas
Dr Sheikh Abdul Rezan S Abdul Hamid
Dr Anashida
Dr Nurzalilah Mohammad Nor
Dr Ooi Lu Ean
Dr Ramdziah Md. Nasir
En. Abdul Yamin Saad

Notes:
1. Registration date: 26/1/2016 at 7.30-8.20 am at Seminar Room, PPK Mekanik, USM Nibong Tebal, Pulau Pinang. Contact person: Kaizat (019-4777158), Pn Hasnah (012-5068684)
2. The certificate of presentation and CD for proceedings can be collected at the registration desk.
3. Lunch and tea will be provided and the colloquium will be carried out in parallel sessions at Seminar room and MEK1 respectively. Please bring your own food/drinks to room as you are allowed to enjoy your food while listening to the speaker. Lunch and tea will be served at the Banquet room.
4. All are invited to the keynote session at the Seminar room at 9-10 am and Keynote speaker 2 after the tea break at 11-12.00 pm.
## Contents:

<table>
<thead>
<tr>
<th></th>
<th>Programme Cover</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, Aim and Objectives</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Committees member and Notes for registration</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Contents</td>
<td>4-5</td>
</tr>
<tr>
<td></td>
<td>Keynote speakers bibliography</td>
<td>6-7</td>
</tr>
<tr>
<td></td>
<td>Colloquium Schedule</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Abstract Book</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MTCPG-01 <em>Tribology Characteristics of Banana Peel as an Additive in Paraffin Oils</em></td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>MTCPG-02 <em>The Effect of Temperatures and Extraction Time on Bio Oil Extracted from Banana Peel Wastes</em></td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>MTCPG-03 <em>Tribological Performance of Low Blend (B5 to B10) Waste Feedstock Biodiesel</em></td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>MTCPG-04 <em>Influence of calcination temperature on structure and magnetic properties of calcium ferrite nanoparticles synthesized via sol-gel method</em></td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>MTCPG-05 <em>Effect of ratio differences of mixed oil between mineral engine oil and RBD palm stearin on tribological performance</em></td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>MTCPG-06 <em>Correlation Of Ron 95 &amp; Ron 97 Grade Fuel Properties To Engine Performance And Emission</em></td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td>MTCPG-07 <em>The Effects Of Elastic Deformation Of A Tool On The Lapping Mechanism</em></td>
<td>14</td>
</tr>
<tr>
<td>10</td>
<td>MTCPG-08 <em>Experimental study of RBD palm olein in different applied loads using pin on disk tester</em></td>
<td>15</td>
</tr>
<tr>
<td>11</td>
<td>MTCPG-09 <em>Shape and Dimension of Dimple Structure for Automotive Components</em></td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>MTCPG-10 <strong>KEYNOTE SPEAKER 1- Associate Prof Kean Aw from New Zealand University : Printing Smart Materials and Structures</strong></td>
<td>17</td>
</tr>
<tr>
<td>13</td>
<td>MTCPG-11 <em>Frictional Mechanisms Of Palm Kernel Activated Carbon-Epoxy (Pcac-E) Composites By Phase Transformation Study</em></td>
<td>18</td>
</tr>
<tr>
<td>14</td>
<td>MTCPG-12 <em>Surface Durability Of Kenaf Fiber/Epoxy Composite With Different Fiber Compositions At Various Temperatures</em></td>
<td>19</td>
</tr>
<tr>
<td>15</td>
<td>MTCPG-13 <em>8 Inch Roll-To-Plate Nanoimprint Lithography (8-R2P-NIL) System</em></td>
<td>20</td>
</tr>
<tr>
<td>16</td>
<td>MTCPG-14 <em>One-dimensional Space charge theory for Thermionic Energy Converters</em></td>
<td>21</td>
</tr>
<tr>
<td>17</td>
<td>MTCPG-15 <em>Measurement Of Surface Deformation In Rolling Contact</em></td>
<td>22</td>
</tr>
<tr>
<td>18</td>
<td>MTCPG-16 <em>The Deciding Factors for SU-8 Photoresist Curing Duration during Nanoimprinting</em></td>
<td>22</td>
</tr>
<tr>
<td>19</td>
<td>MTCPG-17 <em>Cycle plasticity deformation are characterised during high cycle reciprocating sliding wear test of Ti-6Al-4V</em></td>
<td>23</td>
</tr>
<tr>
<td>20</td>
<td>MTCPG-18 <em>The evaluation of hexagonal boron nitride additive in modified jatropha oil as a lubricant for green machining process</em></td>
<td>24</td>
</tr>
<tr>
<td>21</td>
<td>MTCPG-19 <em>Preparation of TiOxCyNz coating powder by carbothermal reduction and leaching from Malaysian ilmenite</em></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>22.</td>
<td>MTCPG-20 <em>Carbothermal Reduction And Nitridation Of Ilmenite With Compressed Natural Gas (Cng)</em></td>
<td>26</td>
</tr>
<tr>
<td>23.</td>
<td><strong>KEYNOTE SPEAKER 2</strong> - Prof Zaidi Mohd Ripin from Malaysia</td>
<td>26</td>
</tr>
<tr>
<td>24.</td>
<td>MTCPG-22 <em>Ethylene Gas Sensing Properties Of SnO₂ Nanowires Synthesized Via CVD Method</em></td>
<td>27</td>
</tr>
<tr>
<td>26.</td>
<td>MTGPG-24 <em>Jig Fabrication for Plate-to-Plate NIL</em></td>
<td>28</td>
</tr>
<tr>
<td>27.</td>
<td>MTCPG-25 <em>Taguchi modeling and optimization of friction coefficient performance of kenaf polymer composite</em></td>
<td>29</td>
</tr>
<tr>
<td>28.</td>
<td>Acknowledgement</td>
<td>30</td>
</tr>
</tbody>
</table>
Keynote Speakers Bibliography:

1. Professor Kean C. Aw

Associate Professor Kean C. Aw has been with the Department of Mechanical Engineering, University of Auckland, New Zealand since 2004. Prior to his academic position, he worked at Intel, Altera and Navman for a total of 11 years. His main interests are in micro-systems and deployment of smart/functional materials and structures such as conducting polymers, metallic oxides etc as sensors and actuators in various applications such as bio-sensors, medical/ rehabilitation robots, micro-pumps, micro-manipulators, MEMS, energy harvester, etc. He has over 130 refereed publications. His main interest is in smart materials and structures in MEMS, sensors, actuators, energy harvesting, etc. and also in biomedical technology - hand assistive glove, bio-sensors, etc.

2. Professor Dr Zaidi Mohd Ripin

Biodata of Professor Zaidi Mohd Ripin,
School of Mechanical Engineering, Universiti Sains Malaysia, 14300 Nibong Tebal SPS, Pulau Pinang, Malaysia.

Professor Zaidi Mohd Ripin holds a degree in Mechanical Engineering (Marine Technology) from the Universiti Teknologi Malaysia in 1989, a masters degree in Tribology in Machine Design in 1991 and a PhD in Vibration Analysis in 1996 from the Department of Mechanical Engineering, University of Leeds, UK. He is a registered engineer with the Board of Engineers Malaysia. His research interest covers a wide area of friction and vibration and has managed to secure various research grants from the government and industry totaling more than RM 2.08 million to date. The more notable
grants are from Advance Micro Devices and Panasonic Manufacturing and also joint research work with Motorola and National Instruments under the CREST Research Collaboration grant. He has graduated 10 PhD and 22 Masters students and currently supervising 3 PhD and 5 Masters students. 

His main area of research is in machine vibration and to date has published more than 200 articles in journals and conference proceedings. In relation to machine lubrication and condition monitoring his research works covers engine lubrication and roller bearing wear surface characterization. The related publications are published in highly respected journals such as Tribology Transactions, Tribology International, Journal of Sound and Vibration, Journal of Vibration and Control, Proceeding of the Institution of Mechanical Engineers and Metallurgical and Materials Transactions to name a few. His primary interests is to uncover the relationship between the surface deformation and wear due to rolling under full flooded and starved lubrication condition which is the primary cause of roller bearing failures in critical applications.

He has conducted training for the Royal Malaysian Air Force on machine condition monitoring and also advises industries on vibration and machine condition monitoring issues. He is also a Honorary Air Force Major of the Royal Malaysian Air Force. He was appointed to the Malaysian National Standard Institute for Metal and Metalworking Committee (SIRIM) and has been appointed as external examiners of engineering programme in the local universities.

He is an avid machine designer as an outcome of his research work which requires the building of experimental rigs and has won many design awards, the notable one is Best Invention Award in International Design and Technology Exposition in 2010 in the design of suspended handle to reduce transmitted vibration to operator of grass trimmer. He is also actively involved in the design of machines for the farmers and craftsman in Malaysia.
## Colloquium Schedule: 26 January 2016 (Tuesday)
### Session 1 & 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 1</th>
<th>Session 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30-9.00am</td>
<td>Opening Ceremony by our Dean of School of Mechanical Engineering</td>
<td>Seminar Room</td>
</tr>
<tr>
<td>9.01-10.00am</td>
<td>Keynote Speaker 1- MTCPG-21</td>
<td>Seminar Room</td>
</tr>
<tr>
<td>Break</td>
<td></td>
<td>Banquet Room</td>
</tr>
<tr>
<td>10.01-10.20am</td>
<td>MTCPG-01</td>
<td>MTCPG-01</td>
</tr>
<tr>
<td>10.21-10.40am</td>
<td>MTCPG-03</td>
<td>MTCPG-04</td>
</tr>
<tr>
<td>10.41-11.00am</td>
<td>MTCPG-05</td>
<td>MTCPG-06</td>
</tr>
<tr>
<td>11.00-12.00pm</td>
<td>Keynote Speaker 2- MTCPG-10</td>
<td>Seminar Room</td>
</tr>
<tr>
<td>12.01-12.20pm</td>
<td>MTCPG-07</td>
<td>MTCPG-08</td>
</tr>
<tr>
<td>12.21-12.40pm</td>
<td>MTCPG-09</td>
<td>MTCPG-11</td>
</tr>
<tr>
<td>1-2.30pm</td>
<td>Lunch</td>
<td>Banquet Room</td>
</tr>
<tr>
<td>2.30-2.50pm</td>
<td>MTCPG-12</td>
<td>MTCPG-13</td>
</tr>
<tr>
<td>2.51-3.10pm</td>
<td>MTCPG-14</td>
<td>MTCPG-15</td>
</tr>
<tr>
<td>3.11-3.30pm</td>
<td>MTCPG-16</td>
<td>MTCPG-17</td>
</tr>
<tr>
<td>3.31-3.50pm</td>
<td>Break</td>
<td>Banquet</td>
</tr>
<tr>
<td>3.51-4.10pm</td>
<td>MTCPG-18</td>
<td>MTCPG-19</td>
</tr>
<tr>
<td>4.11-4.31pm</td>
<td>MTCPG-20</td>
<td>MTCPG-22</td>
</tr>
<tr>
<td>4.32-4.52pm</td>
<td>MTCPG-23</td>
<td>MTCPG-24</td>
</tr>
<tr>
<td>4.53-5.20pm</td>
<td>MTCPG-25</td>
<td></td>
</tr>
<tr>
<td>5.20-5.30pm</td>
<td>Closing session- Seminar room</td>
<td></td>
</tr>
</tbody>
</table>
MTCPG-01

Paper 01

Tribology Characteristics of Banana Peel as an Additive in Paraffin Oils

ABSTRACT

Unstable oil prices, the reduction of crude oil reserves in the world and the demand to protect the environment against pollution are all the factors that have attracted interest of researchers in developing alternative lubricant. Banana peel as a waste material is selected as an additive. The objectives are to propose method of preparing the banana peel as an additive in paraffin oils, to study the effect of load and temperature to the tribology characteristics (friction and wear) and to determine the optimum load and temperature. Banana peel is mixed into paraffin oil in different percentages using ultrasonic homogenizer. Friction and wear tests are performed under different loads and temperatures using four ball testers and inverted microscope respectively. Surface roughness, dynamic and kinematic viscosity implemented using profilometer and Brookfield viscometer respectively. Results are analysed using graphical and analytical approaches. As a yields, lubricant additive obtains 67% of reduction in dynamic and kinematic viscosity, reduce the coefficient of friction to 87.9% and 28% on surface roughness. However, wear increases to 85.4%. The presence of 20% banana peel has affected to the tribology characteristics in terms of low friction and wear. The optimum load and temperature are 250N and 100°C respectively.
The Effect of Temperatures and Extraction Time on Bio Oil Extracted from Banana Peel Wastes

H.A. Hamid\textsuperscript{1}, N.A.B. Masripin\textsuperscript{1,2}*, M.F.B. Abdollah\textsuperscript{1,2}, R. Hasan\textsuperscript{1,2}, G.B. Omar\textsuperscript{1}

\textsuperscript{1)Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.
\textsuperscript{2)Centre for Advanced Research on Energy, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

*Corresponding e-mail: noraznnmi@utem.edu.my

Keywords: oil; extraction; banana peel

ABSTRACT – Bio oil extracted from various part of edible and non-edible plants offer several potential applications such as a biodegradable lubricant. In this study, banana peels which known as waste and often ignored was subjected to solvent extraction via soxhlet method. Moreover, the extraction of oil from banana peels wastes was performed and optimized. The effects of temperatures and extraction time were investigated in order to optimize the extraction conditions for achieving maximum oil obtained. The optimum conditions using \textit{n}-hexane as a solvent of extractor was found at the temperatures of 68°C and 7 hours of reaction times whereby the extraction recovery was 62.42\% with 3.6 mL of oil obtained. The promising oil which obtained then will be used as an alternative lubricant or and as an additive as it offer several advantages compared to mineral lubricants.
MTCPG-03

Tribological Performance of Low Blend (B5 to B10) Waste Feedstock Biodiesel

S.C. Lee¹, N. Tamaldin¹,2*, M.F.B. Abdollah¹,2
¹Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka, Melaka, Malaysia
²Centre of Advanced Research on Energy, Universiti Teknikal Malaysia Melaka, Melaka, Malaysia

*Corresponding author email: noreffendy@utem.edu.my

Abstract

Biodiesel, a new type of diesel fuel was proven to reduce toxic emissions of diesel engine however the lubrication and wear protection of the biodiesel provided was not studied. This study is made to investigate the tribological performance of three types of biodiesel which are decanter cake, spent bleaching clay and waste cooking oil and each of them was blended in 5% and 10% content. The tribological performance of each biodiesel was tested using the Four Ball Test Method with temperature range of 30°C, 45°C, 60°C, 75°C and load of 392 N, 589 N, 785 N, 981 N while spindle speed is at 1200 rpm. At 5% biodiesel content, the friction coefficient reduction ranged from 0.0049 to 0.635 while the wear scar diameter ranged from 0.116 mm to 0.761 mm compared to pure diesel. Addition of 10% content showed minimal reduction of friction and wear scar diameter.

MTCPG-04

Influence of calcination temperature on structure and magnetic properties of calcium ferrite nanoparticles synthesized via sol-gel method

Abstract

The Calcium ferrite (CaFe₂O₄) nanoparticles powder obtained was synthesized through sol-gel method using the calcium nitrate with ferric nitrate as starting material calcined at 300 °C and 550 °C. The effects of calcination temperatures on the crystalline structure, surface morphology and magnetic properties of CaFe₂O₄ nanoparticles were made an observation. The orthorhombic structure of calcium ferrite nanoparticles has been represented by X-ray diffraction. Furthermore the morphology and size (19.71nm) of synthesized nanoparticles have been observed by transmission electron microscopy (TEM) and scanning electron microscopy (SEM), respectively. Moreover, the magnetic analysis has been studied by vibrating sample magnetometer (VSM) where the magnetic saturation magnetized.
MTCPG-05

ABSTRACT

In this study, an effect of ratio differences of mixed oil between mineral engine oil and RBD palm stearin on tribological performance was investigated. This process used a four-ball tribotester as according to the standard test of ASTM D 4172 B. Several tests were conducted with the mixing ratio of 80% engine oil: 20% palm stearin, 60% engine oil: 40% palm stearin and 100% engine oil. 20% engine oil: 80% palm stearin, 40% engine oil: 60% palm stearin and 100% palm stearin. Experimental temperature and load applied were held constantly at 75°C and 40kg. All tests were conducted in the duration of 60 minutes with different speeds applied, at 1600rpm, 2000rpm and 2400rpm. The coefficient of friction (COF) and wear scar diameter (WSD) of each mixture were determined. After the completion of the wear test experiments, the balls wear condition and lubricant properties were examined. Results show that the mixing ratio of 20% EO: 80% PS has lower coefficient of friction compared to 100% engine oil. However, wear scar of mixing ratio of 20% EO: 80% PS shows larger diameter compared to 100% engine oil.
MTCPG-06

MYTRIBOS COLLOQUIUM ABSTRACT

TITLE:
CORRELATION OF RON 95 & RON 97 GRADE FUEL PROPERTIES TO ENGINE PERFORMANCE AND EMISSION

AUTHORS:
Aizuddin Fahmi bin Mohd Riduan, Assoc. Prof. Dr. Noreffendy bin Tamaldin, Dr. Ahmad Kamal bin Mat Yamin

ABSTRACT:
To analyze different fuel properties available in the market and finding relationship between its attributes to engine performance and emission. The preliminary research was divided into two parts, investigation of fuel characteristics and engine performance testing. Fuel properties such as density and energy content were examined using a hydrometer and oxygen bomb calorimeter respectively. Engine performance and emission testing were done using an engine dynamometer and gas analyzer. Further research was done by using two vehicles with the same engine capacity but different fuel system, one being carbureted and the other fuel-injected. Both were tested using chassis dynamometer. All tested brands showed trend of having different attributes for low and high fuel octane rating. The higher fuel grade exhibited greater values for each properties studied compared to the lower fuel grade. Engine performance and emission shown to be distinct when tested with different gasoline research octane number. Difference in vehicle fuel systems also produce results that are not alike for fuel consumption. The experiment outcome have presented that different fuel grades can give more significant distinct figures on engine performance and emission than originally expected. The effective long-term running cost for each fuel grade was also align with the engine testing results.

KEYWORDS:
Fuel properties; Engine performance; Emission
THE EFFECTS OF ELASTIC DEFORMATION OF A TOOL ON THE LAPPING MECHANISM

A. H. ABOUELEZZ 1, K. FUKUDA 1, Ikuo TANABE 2, A. L. MOE 1, Z. A. SUBHI 1, J. Ishimatsu 1

1 Tribology and Precision Machining i-Kohza (TriPreM), Malaysia Japan International Institute of Technology (MIIT), Universiti Teknologi Malaysia (UTM), 54100, Jalan Sultan Yahya Petra, Kuala Lumpur, Malaysia

2 Department of Mechanical Engineering, Nagaoka University of Technology, Nagaoka, Japan.
Email: ammanhosam@gmail.com

ABSTRACT
Lapping is one of the highest precision machining processes which have the capability to produce excellent surface qualities with higher geometrical form and generally it is conducted as the manual process by a skilled worker. The productivity of these manual processes is lower than other finishing processes and difficult to be controlled. A lapping system consists of: simple lapping tool including a lapping head, a spring to supply the lapping pressure by compression, and a holder installs in the CNC milling machine, was developed. Several materials were machined as mirror like surface using the developed system. The lapping conditions are usually decided by skilled worker's experience or know how. Therefore, in this study, we study and analyze the effects of the elastic deformation of the lapping tool and how it affected the diamond grains embedded in the tool, effective machining area for the tool, the critical pressure applied to the tool and in the lapping operation, and the optimum incremental movement of the tool that affected the lapping quality to obtain a better surface finish.

Keywords: Lapping Tool, slurry, Modification, Mirror-Like surface
Experimental study of RBD palm olein in different applied loads using pin on disk tester

*M. I. Izhan*1, **S. Syahrullail

1School of Graduates Studies,
Universiti Teknologi Malaysia,
81310, UTM Skudai, Johor.
*Corresponding author’s email*: mohdzhan88@gmail.com

Faculty of Mechanical Engineering,
Universiti Teknologi Malaysia,
81310, UTM Skudai, Johor.
*Email*: syahrul@fkm.utm.my

Abstract. The vegetable oil based lubricant as lubricant in various applications were intensified and eyed by the industry due to its superior tribological properties and has potential to replace petroleum based lubricants which were currently widely used by the industry. RBD palm olein could be suitable and attractive candidate as the lubricant to be studied due to its good advantages and large production in country. Thus, in the research the tribological behavior of RBD palm olein was investigated by using pin on disk tester in which the hemispherical pin was loaded against the rotating grooved disk. The experiments by sliding were performed on pin on disk tester using titanium as material for both hemispherical pin and grooved disk. The test were implemented by dropping 5ml of RBD palm olein as lubricating oil on sliding surface at different loads applied which were 5N, 10N, 20N, 40N and 80N. The test were repeated five times and compared mutually using hydraulic oil and free paraffinic mineral oil. In this study, the friction coefficient and surface roughness were investigated. From the analysis, friction coefficient acquired lubricated with RBD palm olein was the lowest for all applied loads. The arithmetic surface roughness of the pin and disk, $Ra$ also show the lowest value for both pin and disk by using RBD palm olein as lubricant. RBD palm olein used as lubricant in pin on disk concluded and summarised as great lubricating oil because has no formula additive replenished specifically reducing friction coefficient at various applied load.

Keywords: pin on disk, RBD palm olein, wear, friction, loads, surface roughness
Shape and Dimension of Dimple Structure for Automotive Components

Sharudin Hassan, Jaharah A. Ghani, Che Hassan Che Haron
Politeknik Ungku Omar, Jalan Raja Musa Mahadi, Perak, Malaysia
Department of Mechanical and Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia

Abstract

The growth of global automotive industry is very fast which in line with the advancement in machining technology. The use of modern machining technology has enabled the manufacturing process to grow rapidly to meet the global demand. The demand for cost saving and high performance vehicle is the main key in the current and future of the automotive industry. Fuel saving and engine performance are closely related to the engine efficiency of the vehicle component such as friction. Surface texturing is one of the techniques explored to reduce friction in engine component in the automotive industry. It was proven that surface texturing like dimple structure can improve the tribology property of a sliding surface. Suitable shape and dimension for dimple structure should be further investigated for various condition of the lubrication regime on the vehicle component to increase the engine efficiency.

Keyword: dimple structure, friction, surface texturing
Printing of Smart Materials and Structures

Kean C. Aw
University of Auckland
New Zealand

ABSTRACT

The ability to print smart materials especially at different scale (micro or meso-scale) has gained significant interest. The use of various smart materials such as conducting polymer, piezoelectric materials, etc can be exploited when printed on or as unique 3D or 2D structures. Together with clever printing of 2D or 3D smart structures, different types of transducers can be achieved.

In this presentation, I will present the 3D printing of conducting polymer such as polypyrrole and PEDOT for various applications. Then it will be followed by the printing of flexible conductive traces that can be used to provide conductive path to emerging soft actuators and finally the use of these printed stretchable traces as sensor.

Brief Biography

Dr. Kean C. Aw (KC) is an Associate Professor of mechatronics engineering at the Department of Mechanical Engineering, University of Auckland, where he is also the Deputy Head of Department (research) and leads the micro-systems and smart materials research. He joined the University of Auckland on March 2004. He is involved with the teaching of Mechatronics program at the University of Auckland. His main interests are in micro-systems and deployment of smart/functional materials and structures such as conducting polymers, metallic oxides, etc as sensors and actuators in various applications such as bio-sensors, medical/rehabilitation robots, micro-pumps, micro-manipulators, MEMS, energy harvester, etc. He has ~150 publications to date. Before joining the University of Auckland, he worked at several multinational companies for over a decade such as Intel Corporation, Altera Corporation, Nanan Ltd in various roles in Device Reliability, Device Characterization & Failure Analysis and Product Validation.
FRICTIONAL MECHANISMS OF PALM KERNEL ACTIVATED CARBON-EPOXY (PKAC-E) COMPOSITES BY PHASE TRANSFORMATION STUDY

D.N.F. Mahmod1, M.F.B. Abdollah1,2*, N.A.B. Masripan1,2*

1) Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.
2) Centre for Advanced Research on Energy, Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

*Corresponding author: mohdfs@utem.edu.my
Telephone: +606 234 6805/6914

Abstract

The purpose of this research to investigate the characteristics of tribofilm formation and phase transformation of PKAC-E composites at different temperatures under dry sliding conditions. The sample of PKAC-E composites will be formed into a pin using a hot compaction technique. After that, the tribological test will be conducted using a pin-on-disc tribometer at different operating temperatures. The phase transformation of worn surfaces and tribofilm formation will be examined using Raman Spectroscopy. Surface morphology will be observed by SEM/EDX, profilometer and Shore D durometer. It is expected that the phase transformation of carbon-like structure to graphite-like structure of PKAC-E composites will cause a reduction of friction coefficient. Other than that, some adhesive and abrasive wear types will be identified on the worn surfaces. Investigation on the tribofilm formation characteristics and its phase transformation studies are beneficial for further friction coefficient reduction of PKAC-E composites in order to be a new self-lubricating material.

Keyword

Phase transformation; Carbon; Friction
SURFACE DURABILITY OF KENAF FIBER/EPOXY COMPOSITE WITH DIFFERENT FIBER COMPOSITIONS AT VARIOUS TEMPERATURES

F.F. Shuhimi¹, M.F.B. Abdullah¹, ², M.A. Kalam¹, H.H. Masjuki³, A. Mustafa¹, H. Amiruddin¹, ²

¹) Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka, 
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.
²) Centre for Advanced Research on Energy, Universiti Teknikal Malaysia Melaka, 
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.
³) Department of Mechanical Engineering, Faculty of Engineering, University of Malaya, 
50603 Kuala Lumpur, Malaysia.

*Corresponding author: mohafizahzi@utem.edu.my
Telephone: +606 234 6805/6914

Abstract

The aim of this paper is to study the surface durability of Kenaf/Epoxy (KF/E) composite in term of tribological performance at different temperatures. The tribological test was carried out by using a pin-on-disc tribometer in dry sliding conditions by applying various temperatures from 23 °C to 150 °C and was tested against JIS-SKD 11 (AISI D2) steel disc. Different fiber loadings were prepared; namely, 30%, 50% and 70% weight percentage. Surface durability was determined by the value of friction coefficient and wear rate with respect to the temperatures. The microstructures of worn surfaces are also presented to study the wear behavior using scanning electron microscopy (SEM). The results reveal that surface durability of all composite compositions can withstand at a maximum of 50°C as transition mild to severe wear has occurred. In addition, it was found that 70 wt.% of fiber exhibited the best tribological performance with low friction coefficient and wear rate. The implications of the results that presented here may facilitate improvements in the future study for tribological applications.

Keywords: Kenaf fiber, temperature; durability; wear; friction
8 INCH ROLL-TO-PLATE NANOIMPRINT LITHOGRAPHY
(8-R2P-NIL) SYSTEM

Lai Seng Lee¹, Khairudin Mohamed¹, Su Guan Ooi²

¹,²,³ Nanofabrication and Functional Materials Research Group,
School of Mechanical Engineering, Universiti Sains Malaysia,
Engineering Campus,
Nibong Tebal, 14300 Penang, Malaysia

Tel: +604 599 5860   Fax: +604 594 1026   Email: mekharudin@usm.my

Abstract
Moore’s law forecast the progression of change in semiconductor technology nodes, this drive semiconductor industry to continually seek for substitute patterning method. Photolithography process becomes hard when the pattern feature size progress lower than 45 nm. The objectives of this work is to develop a high throughput, low imprint force, room temperature UV assisted 8 inch roll to plate nanoimprint lithography system capable of imprinting nanostructures on 200 mm silicon wafer using quartz roller with flexible mold. Wafer substrate placed on vacuum chuck drives forward by a stepper motor. The imprinted nanostructures is cured by UV LED which situated inside the quartz roller. Heat generated by UV LED is dissipated by heat sink with fan. The flexible mold detaches from imprinted nanostructures in a ‘line peeling’ pattern and imprint pressure is measured by ultra-thin force sensors. This system has imprinting capability of 20 pieces of 8 inch wafers per hour. Speed synchronization between imprint roller and vacuum chuck is achieved by controlling pulse rate supplied to stepper motor. Vacuum chuck height is controlled by stepper motor with displacement of 5 nm/step.

Keywords: Nanoimprint Lithography, quartz roller, UV LED.
One-dimensional Space charge theory for Thermionic Energy Converters

Kamarul Aizat Abdul Khalid, Khairudin Mohamed

1,2 Nanofabrication and Functional Materials Research Group,
School of Mechanical Engineering, Universiti Sains Malaysia,
Engineering Campus,
Nibong Tebal, 14300 Penang, Malaysia

Tel: +604 599 5860 Fax: +604 594 1026 Email: mekhairudin@usm.my

Abstract

Thermionic energy converters (TECs) have been a promising prospect for direct clean energy generation since they can work conveniently at very high temperature inlet and are predicted to have a significantly higher efficiency than the present conventional methods. Despite their great potential, the development and applications of TEC have been limited in the past due to low performance of practical devices. Two main factors hindering highly-efficient TECs are the necessity for low work function materials for sufficient current densities and the space charge cloud formation in the inter-electrode space that drastically reduce the overall energy conversion efficiency. This paper presents the influence of space charge (SC) effect on the net current density which results in the power conversion efficiency based on established space-charge theories which is the Langmuir theory for one-dimensional (1D) TEC. The electrostatic potential of SC is found by solving the Poisson equation which is then used to define the electron motion in the inter-electrode space under the influence of the SC potential.

Keywords: Thermionic energy conversion, space charge, work function, energy conversion efficiency
MEASUREMENT OF SURFACE DEFORMATION IN ROLLING CONTACT
Nurul Farhana Mohd Yusof, Zaidi Mohd Ripin
nfarhana101@gmail.com
School of Mechanical Engineering, Universiti Sains Malaysia
14300 Nibong Tebal, Pulau Pinang, Malaysia.

ABSTRACT

A new test rig is developed to measure the progressive surface deformation in rolling contact. The rig size is relatively small to the infinite focus microscope to enable experiment to be carried out under the scope. The online measurement of surface deformation is performed periodically at the early cycle of rolling contact. The results showed that the rig can be used to quantify minor surface deformation up to nano-scale and surface image repositioning method is not required as the position of the initial profile and the subsequent profile over the complete rolls did not show any shift. The experimental results are used for the finite element analysis of actual rough surface for further analysis on the surface stress and contact area.

The Deciding Factors for SU-8 Photoresist Curing Duration
during Nanoimprinting
Ooi Su Guan¹, Khairudin Mohamed²

Email: ¹edwin-ooi90@hotmail.com, ²mekhairudin@eng.usm.my

Photoresist is a light sensitive material used in several industrial processes, such as photolithography and nanoimprint lithography, to form a patterned coating on the desired surface. Among the choices of several photoresists, SU-8 photoresist is commonly used for it is very resistant to solvents, acids and bases and have excellent thermal and mechanical stability. Due to SU-8 photoresist is sensitive to near UV (365nm) radiation, it’s important to know the curing duration to get the desired pattern, especially in micro/nano scale. In this paper, several factors and their significance in affecting the quality of the product will be discussed.

Keywords: SU-8 photoresist, nanoimprinting
MTCPG-17

Cycle plasticity deformation are characterised during high cycle reciprocating sliding wear test of Ti-6Al-4V

Nurarina Nurdin, Abdul Latif Tobi

Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya, 76100 Durian Tunnggal, Melaka, Malaysia.

ABSTRACT

Reciprocating sliding widely experience wear in most majority of mechanical components during their service life. It reduces the performance of the components. The capability to predict the evolution of reciprocating wear scars, such as the scar’s width and depth, would be a valuable tool when designing mechanical components. Cycle plasticity deformation are characterised during high cycle reciprocating sliding wear test of Ti-6Al-4V investigated using pin-on-flat arrangement under variable applied load and frequency of sliding. Dry sliding wear tests were carried out on a cylinder-on-flat sliding configuration using Ducom sliding wear reciprocating test rig machine. The effect of load, duration of cycle, and size of pin are the parameter that consider in this study. The results of plasticity characteristic are analyzed using profilometric test (3D OM), optical microscope (2D OM), Field-Emission Scanning Electron Microscope (FESEM), energy depressive x-ray (EDX) and Vickers hardness (HV). It is shown that the wear rate starts to stabilize with increasing duration of cycles by seen the value of weight loss over the duration of the cycle. Hardness test shows that the mechanism for wear scar is changed by the developers of the black spot that mostly found at the edge of track. The black spot region has higher value of hardness imply that due to cyclic plasticity deformation. The prediction that plasticity occurred at the black spot are determined by FESEM analysis. The predicted of characteristic and delamination wear mechanism of high cyclic plasticity wear between fretting and reciprocating are determined.
The evaluation of hexagonal boron nitride additive in modified jatropha oil as a lubricant for green machining process

N. Talib\textsuperscript{1, a}, E. A. Rahim\textsuperscript{1, b}, R.M. Nasir\textsuperscript{2, c}

\textsuperscript{1}Precision Machining Research Center (PREMACH), Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, Malaysia

\textsuperscript{2}School of Mechanical Engineering, Universiti Sains Malaysia (Engineering Campus), Seri Ampangan, 14300 Nibong Tebal, Seberang Perai Selatan, Pulau Pinang, Malaysia

Email: \textsuperscript{a} fazillah@uthm.edu.my, \textsuperscript{b} erween@uthm.edu.my, \textsuperscript{c} ramdziah@usm.my

During the recent years, the bio-based lubricant is extensively explored to be implementing in green manufacturing industries to protect the environment against pollution and health hazard due to the usage of mineral oil-based lubricant. Bio-based oils from vegetable oil are being demanded on various manufacturing applications. However, the limited range of properties causes some inconveniences for their purpose as the lubricant. Accordingly, the chemical modification process and additives should be involved in lubricant reformulation. In this study, various samples of modified jatropha oils (MJOs) were formulated by using transesterification process denoted by MJO1, MJO3 and MJO5. Later, MJOs were blended with hexagonal boron nitride (hBN) particles to enhance the tribological performances at various concentration percentage ratios. The performances of all samples were analysed via tapping torque test and orthogonal cutting process. All samples were compared with commercially synthetic ester (SE). In this sense, the results revealed that the formulation of MJO5 with 0.05wt.\% of hBN particles as a lubricant exhibit excellent machining performances as it reduced the thrust force, torque, chip thickness and tool-chip contact length compared to the SE.
Preparation of TiO$_x$C$_y$N$_z$ coating powder by carbothermal reduction and leaching from Malaysian ilmenite


School of Materials & Mineral Resources Engineering, Universiti Sains Malaysia, 14300 Nibong Tebal, Penang, Malaysia, and Tel.: +60173206821

*srsheikh@usm.my

ABSTRACT

Ti(C,N) coatings, having excellent tribological performance, have been widely used as industrial wear-resistance materials in cutting tools and high speed steel (HSS) mills. This article describes a two-stage preparation method for titanium oxycarbonitride (TiO$_x$C$_y$N$_z$) powder by carbothermal reduction and nitridation (CTRN) of Malaysian Ilmenite (FeTiO$_3$) minerals in the H$_2$-N$_2$ atmosphere and the subsequent aeration leaching of iron in NH$_4$Cl solution. CTRN experiments have been carried out in the temperature range of 1100-1250°C for 3 hours with a reductant consisting of a mixture of coal from Mukah-Balingan Sarawak and Polyethylene Terephthalate (PET). The reductant was a mixture of 25 wt.% coal-75 wt.% PET with a carbon to reducible oxygen molar ratio of 4. X-ray diffraction (XRD), X-ray Fluorescence (XRF), Scanning Electron Microscopy (SEM) and Energy dispersive X-ray analysis (EDX) analysis were conducted as part of the characterization on the samples. XRD and SEM results showed that it was feasible to convert local Malaysian ilmenite mineral to a wear-resistance composition of TiO$_x$C$_y$N$_z$ powder with minimal intermediate titanium suboxides phases. The degree of reduction was approximately 95% which indicated a preliminary oxycarbonitride phase of TiO$_{0.1}C_{0.3}N_{0.6}$. The changes in stoichiometry (x, y, z) will allow precise tailoring of the wear resistant, hardness, thermal and electrical conductivity of the oxycarbonitride.

Keywords: Coating material, titanium oxycarbonitride, carbothermal reduction, polyethylene terephthalate, coal
CARBOTHERMAL REDUCTION AND NITRIDATION OF ILMENITE WITH COMPRESSED NATURAL GAS (CNG)

Najwa Binti Ibrahim\textsuperscript{1}, Lee Chee Keat\textsuperscript{1}, Eltefar Ahmadi\textsuperscript{1}, Sheikh Abdul Rezan\textsuperscript{*1}, Sivakumar Ramakrishnan\textsuperscript{1}, M.N. Ahmad Fauzi\textsuperscript{1} And Abdul Rahman Mohamed\textsuperscript{2}.

\textsuperscript{1}School of Materials & Mineral Resources Engineering, Universiti Sains Malaysia, 14300 Nibong Tebal Penang, Malaysia, and Tel.: +60173206821,
\textsuperscript{2}School of Chemical Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Pulau Pinang.
Email: srsheikh@usm.my

In this project, the reduction of Malaysian ilmenite by compressed natural gas (CNG) with hydrogen-nitrogen gas mixture was performed to produce titanium oxycarbonitride (TiOxCyNz) and iron. The experiment has been carried out at temperature range 1100–1200 °C for about 1-3 hours with varying CNG flow time. CNG gas concentration use was 10 vol. % while a 45-45 vol. % of H2-N2 was the remaining reductant gas. A 2k factorial design has been used to analyze data and to predict the extent of reduction and nitridation respectively. The results achieved in this project indicate that TiOxCyNz was formed at 1200°C for 180 min with CNG flow time of 45 min, and the extent of reduction was about 86.95% with carbon deposited was 62.4%. This gave a stoichiometric composition of TiO0.26C0.02N0.60. The titanium oxycarbonitride synthesized have very similar properties to Titanium Nitride (TiN) which have numerous application in tribology and wear resistant coatings.

\textbf{Keywords}: Ilmenite, CNG, Titanium oxycarbonitride

MTCPG-21

Keynote speaker- Prof Zaidi Mohd. Ripin

"Surface - Where it matters"
ETHYLENE GAS SENSING PROPERTIES of SnO$_2$ NANOWIRES SYNTHESIZED VIA CVD METHOD

Maisara A. M. Akhir$^a$, Khairudin Mohamed$^b$ and Sheikh A. Rezan$^c$

$^a$ School of Bioprocess Engineering, Universiti Malaysia Perlis, Kompleks Pusat Pengajian Jejawi 3, 02600 Arau, Perlis, Malaysia
$^b$ School of Mechanical Engineering, Universiti Sains Malaysia, 14300 Nibong Tebal, Penang
$^c$ School of Materials & Mineral Resources Engineering, Universiti Sains Malaysia, 14300 Nibong Tebal Penang, Malaysia

mekhairudin@usm.my

Abstract

Tin oxide (SnO$_2$) nanowires (NWs) were synthesized using chemical vapor deposition (CVD) technique. SnO$_2$ NWs with average diameter of 42 nm and ~240 nm were deposited onto the alumina substrate with printed gold electrodes and tested for sensing characteristic toward low concentrations of ethylene (C$_2$H$_4$) gas mixed with nitrogen. SnO$_2$ NWs showed a unique response in which its resistivity increased when exposed to C$_2$H$_4$ gas. Furthermore, the optimum operating temperature for SnO$_2$ NWs gas sensing sensitivity (S) decreased from 450$^\circ$C to 125$^\circ$C. The sensitivity changed from 9.2 to 4.6 which was an overall decreased of 50%. This observation can be explained by diffusion of SnO$_2$ NWs crystal structure due to Wadsley defects caused by high concentration of ethylene gas molecules. The work presents a successful fabrication of SnO$_2$ NWs gas sensor that can operate at both high and low concentration of C$_2$H$_4$ gas with varying sensitivity.
MTCPG-23

MAGNETIC UNDERLAYER SURFACE PLANARIZATION IMPACT ON MAGNETIC DISK RELIABILITY PERFORMANCE

W. S. Kho$^1$, R. N. M. Ramdziah$^1$, M. R. Zaidi$^1$

$^1$ Nanofabrication and Functional Material Research Group
School of Mechanical Engineering, Universiti Sains Malaysia,
14300 Nibong Tebal, Bukit Gambang, Penang

$^2$ Fuji Electric Malaysia,
09000 Kulim Hi-Tech Industrial Park, Kulim, Malaysia.
Corresponding author’s khoo-weeshen@fujielectric.com

Abstract

Hard disk media is made up of Co-Pt based alloys based magnetic thin films. The magnetic thin film is a granular structure, forming individual grain. The magnetic thin film is protected by carbon overcoat and lubricant thin film. The magnetic material and the carbon overcoat is sputtered on aluminium or glass substrate. The demand for more data storage leads to areal density improvement on HDD media. This can be achieved through the reduction of the magnetic head to magnetic layer spacing. However there are concerns with the reliability of the hard disk media. One primary concern is the corrosion resistance performance especially at thin carbon overcoat film thickness. Corrosion tends to become worse at thin carbon overcoat film. In this study, surface planarization on the magnetic underlayer was attempted. The surface planarization step was done with Ar gas with different etching energy (90eV and 210eV). The etching effect was confirmed by the increase of magnetic underlayer coercivity. Surface roughness of the film was measured with optical surface analyzer. Smoother surface was obtained with higher etching energy. Surface planarization gives better corrosion performance at same carbon thickness. 90eV etching energy shows good corrosion performance with acceptable particle level generation.

MTCPG-24

Jig Fabrication for Plate-to-Plate NIL

Khi Khim Beh$^1$, Fahmi Samsuri$^1$ and Khairudin Mohamed$^2$

$^1$ Faculty of Electrical & Electronics Engineering, Universiti Malaysia Pahang, Pekan Campus, 26600 Pekan, Pahang, Malaysia

$^2$ Nanofabrication and Functional Materials Research Group,
School of Mechanical Engineering, Engineering Campus, Universiti Sains Malaysia,
14300 Nibong Tebal, Penang, Malaysia
012-4218287 dragonbeh@gmail.com

Abstract

In recent years, low-cost micro and nano fabrication process have gained interests from the manufacturing industry. Biochip is a platform of miniaturized microarrays arranged on a solid substrate that allows various biological tests to achieve immediate results. The technology of biochip has established a new platform in biomedical industry. However, to fulfill the demands and availability in the market with affordable cost requires high throughput manufacturing techniques for the fabrication of the biochips. In this article, we will discuss the hardware fabrication for imprint microchannel on Polyethylene terephthalate (PET) substrate by using plate-to-plate jig. The fabrication of this jig enabled imprint microchannel and monitor the force and UV intensity parameter in for the upcoming roll-to-roll machine.
Taguchi modeling and optimization of friction coefficient performance of kenaf polymer composite.

A. Mustafa1, M.F.B. Abdollah1,2,*, H. Amiruddin1,2, F.F. Shuhimin3, N.A.M. Tahir1, N. Muhammad1,2, S.E. Mat Kamal1,2, N. Ismail1,2,3

1) Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Dian Tunjgal, Melaka, Malaysia
2) Center for Advanced Research on Energy, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Dian Tunjgal, Melaka, Malaysia
3) Department of Surface Technology and Tribology, Faculty of Engineering Technology, University of Twente, P.O. box 217, 7500 AE Enschede, The Netherlands

*Corresponding e-mail: mohd@utm.edu.my

Keywords: Kenaf, polymer composite, friction coefficient

Abstract

The purpose of this study is to determine optimal design parameters for obtaining higher friction coefficient (μ) for kenaf/epoxy (KE) composites. Design of experiment (DoE) was constructed using Taguchi method, which consist of mixed L12 orthogonal array. KE specimens were formed into 10-mm diameter pins using hot-cold compression machine with a different types (powder/kenaf), % vol kenaf concentration (30-60%), treatment (non-treat/treated/bleached) used. The samples are tested at different load (19.62-98.1N), speed (0.7-3.6ms⁻¹), and operating temperature (24-150°C) using a pin-on-disc tribometer according to ASTM G99 under dry sliding condition. According to an analysis of Signal to Noise (SN ratios), means and Analysis of Variance (ANOVA), to obtained highest μ, 45wt% non-treated kenaf fiber (sample) sliding at 19.62N, 500rpm and 100°C (testing parameters) is found to be the optimized combination of levels of all the six controlled factors and parameters. In confirmation test, the optimized KE sample is compared with conventional friction material on optimized testing parameters. The result found that μ of KE composite is within the range of suggested for friction material application. The surface worn morphology was characterized using scanning electron microscopy (SEM), profilometer and shore D durometer.
Acknowledgement

NFM Group in Collaboration with MyTribos would like to express a tremendous appreciation and gratitude to School of Mechanical Engineering, USM; especially to all keynote speakers, committee members, presenters and reviewers who relentlessly coorporate and present their research works in the 1st. MyTribos Colloquium for Post Garduates 2016. Many thanks.