

## NAME AND CONTACT DETAILS

**PI:** Rocco Lupoi    **DOB:**

**Institution:** Trinity College Dublin, The University of Dublin, School of Engineering.

## CAREER PROFILE

### **Education**

October 2004 - October 2008: PhD in Mechanical Engineering, University of Bath, UK.

Thesis Title: “Effect of shape, size and material on energy dissipation in Equal Channel Angular Extrusion”, supervised by Prof. Fayek Osman.

October 1998 - July 2004: LAUREA IN INGEGNERIA MECCANICA (MEng equivalent in Mechanical Engineering), Politecnico di Torino, Italy. First Class Honours. Final score of 106/110 (Vecchio Ordinamento route).

### **Employment**

July 2012 - Current: **ASSISTANT PROFESSOR, School of Engineering, TCD, Ireland.**

Appointed to this role under permanent term conditions to support teaching and research activities. This post has allowed the PI to become an INDEPENDENT INVESTIGATOR.

Dr. Lupoi was awarded of *Accelerated Advancement promotion in 2016*, due to a recognized exceptional performance primarily in research (the success rate for those who apply is very low). This award allows for a multiple jump in pay scale, not typically awarded.

June 2012 - July 2012: **ACADEMIC VISITOR, Centre for Industrial Photonics (CIP), Institute for Manufacturing (IfM), Department of Engineering, University of Cambridge, UK.**

Appointed Academic Visitor to support the Centre for Industrial Photonics (CIP) research group in Cambridge University in relation to special coatings processing and analysis.

March 2008 - May 2012: **RESEARCH ASSOCIATE, Centre for Industrial Photonics (CIP), Institute for Manufacturing (IfM), Department of Engineering, University of Cambridge, UK.**

Worked as lead researcher in projects funded by the EPSRC, TSB and IKC in the area of laser precision manufacturing, Cold Spray and Computational Fluid Dynamics.

October 2004 - May 2006: **TEACHING ASSISTANT, Department of Mechanical Engineering, University of Bath, UK.**

Assisted and taught students to understand and solve project and tutorial problems.

## INNOVATION / COMMERCIALIZATION ACTIVITY

- Formed a spin-out company with co-workers in 2011, [Laser Fusion Technology](#) Ltd. Dr Lupoi acted as Technical Consultant and Technical Manager before joining TCD.
- R. Lupoi, A. Cockburn, W. O’Neill, M. Sparkes, M. Bray “Deposition of Coatings on Substrates”, [US20140234551](#). Patent Application.
- R. Lupoi, T. Robinson “Cold Spray deposited material for enhanced boiling heat-transfer”, submitted invention disclosure to TTO office in Trinity - September 2015.
- R. Lupoi, T. Robinson “Copper-Diamond Composite Heat Spreaders using Cold Spray Additive Manufacturing Technique” submitted invention disclosure to TTO office in Trinity - May 2016. This IDF has been filed in the form of a patent application (17189219.3-1552).

## KEY ACHIEVEMENTS

### **1- Dr. Lupoi’s PhD work made it to EUREKA magazine front cover**

In May 2005, Dr Lupoi’s PhD programme was outlined in the front cover of EUREKA magazine. The research programme was about the development of a very innovative energy dissipation device, based upon the principles of Equal Channels Angular Extrusion. The working mechanism is unique, as it would allow for a device to be used without being destroyed (as opposite to more conventional metal bars or car bumpers for example). The idea that one could envisage this technology for vast applications in engineering was the key topic



of the article, and further formalized in the concept of a Universal Re-Usable Energy Absorption Device (UREAD). The article in EUREKA would have not been possible without the ground-breaking early stage work of Dr. Lupoi and dissemination in journal and conference papers to include a Keynote presentation in the AMPT 2005 conference in Poland, see CV section for details (being invited for a keynote, during PhD studies, is a major achievement); it is certainly not easy to attract the press attention, and can only materialize for the very best good stories.

This is an achievement Dr. Lupoi feels very proud of, that has led to an industrial engagement (Airbus and Ferrari for example); UREAD was proposed as a possible solution to improve the crashworthiness behaviour of large aircrafts after the BA flight crash in Heathrow airport in 2004.

## 2- Dr. Lupoi establishes the first Cold Spray lab in Ireland

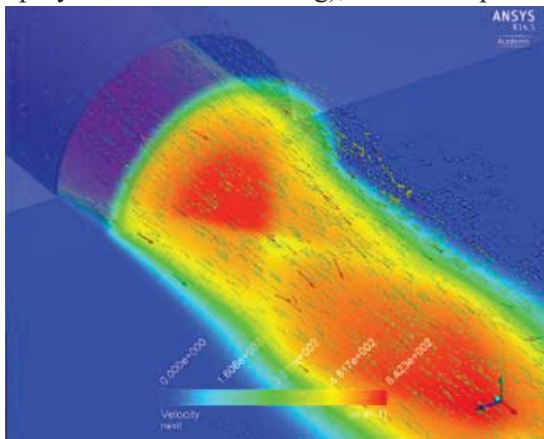
Dr. Lupoi joined Trinity College Dublin in July 2012, coming from a long post-doctoral experience in Cambridge University (UK). He has brought very new expertise to TCD and Ireland, and research experience in material science, metallurgy, metal-Additive Manufacturing (specifically using a process known as Cold Spray). Despite all the good intentions, it was not possible (due to financial constrains) to allocate any institutional research funding to Dr. Lupoi, nor PhD or Master students, or a budget to spend in consumables or equipment.

Dr. Lupoi had to manage the development of his very own resources starting from zero and alone, beginning from the formation of new industry contacts that could provide support. It was finally possible, in March 2014, to inaugurate the first (so far the only) Cold Spray lab in Ireland.

Considering the described circumstances, Dr. Lupoi feels this is an outstanding achievement which has had a tremendous impact in terms of follow on grants (the current total is of approximately €1.7M), industry engagements (in Ireland and the EU), publications and international recognition.

## 3- Marie Curie Fellowship award

In December 2013 Dr. Lupoi became Marie Curie Fellow, through the award of a prestigious individual CIG grant. This is an outstanding achievement, considering the low success rate of such project schemes. The work (running till December 2017), under the acronym of SSAM (Supersonic Spray Advanced Modelling), has developed the tools for the next generation computational modelling



of supersonic flows with particulates. Specifically, the core of the work consisted in the development of a very new experimental set up that would allow to measure micro-particles behaviour accelerated inside a supersonic nozzle by a carrier gas (nitrogen or helium). This is a difficult task; it was however possible to solve it by using a radically new methodology based upon Particle Image Velocimetry combined with a very special nozzle made out of quartz. Dr. Lupoi is the first in the world to have generated such measurements, just presented in the [International Thermal Spray](#) conference in Germany (June 2017). Mr. Meyer (a PhD student working in

this project) came second in the [Young Professional Award competition](#) in this conference, which typically accepts over 400 papers in the proceedings. Previously, he also received the best paper award at the 31<sup>st</sup> IMC conference held in Cork (Ireland) in 2014, also a significant achievement.

The impact of this work will be high. It will be possible to engineer more accurate numerical codes, for example for Cold Spray applications. In this particular case, thanks to Dr. Lupoi's work, experimental data is now available for 60-80% of the area of interest; as opposed to the recent past where empirical measurements would not cross the 15-20% range. Most importantly, journal publications with industry (Siemens and EnBio) has also been produced; this confirms a much wider interest and beyond the academic environment.

*M.C. Meyer, S. Yin, K.A. McDonnell, O. Stier (Siemens), R. Lupoi, Feed rate effect on particulate acceleration in Cold Spray under low stagnation pressure conditions, Surface and Coatings Technology, 2016.*

C. Stenson, M.C. Meyer, B. Twomey (EnBio) and **R. Lupoi**, *Particle speed analysis in CoBlast*, CIRP Procedia, 2015.

#### 4- Dr. Lupoi leads ESA funded major research in Additive Manufacturing

In 2014 Dr. Lupoi secured a large grant (€500,000) from the European Space Agency (ESA) to



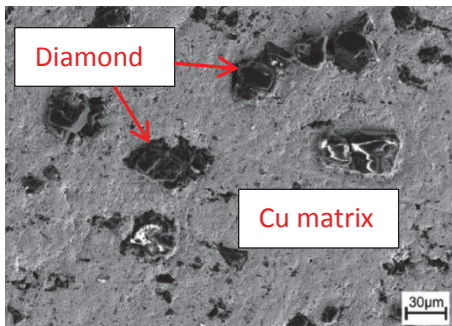
explore the fundamentals and capability of Cold Spray (CS) for additive manufacturing applications of metal alloys for space. This is a great achievement and success story, as this happened to be the largest individual ESA grant ever awarded to TCD (Dr. Lupoi's affiliation) at the time. The project featured in the Irish Times (January 2015), generating high exposure and that being in itself a great accomplishment. CS is a spray method that uses carrier gases travelling at supersonic speed, such as nitrogen or helium, to accelerate micron-sized particles. Upon striking against a surface, the particle will deform and stick to it; it is

therefore possible to produce coatings or 3D geometries at exceptionally fast rates (>300g/min.) without melting materials; hence HAZ, micro-structural changes and thermal distortion can be avoided. The project has so far generated very interesting outcomes with high impact, that have been exploited at academic level (journal publications) or being used as validation point to consolidate and certify CS as method the space industry will use for specific applications. As an example, initial promising results have flagged the ESA attention towards the FLPP (Future Launchers Preparation Programme) scheme. CS was successfully used to 3D print (in Dr. Lupoi's lab) aluminium flanges that could be implemented in lighter-weight future rocket engines; initial structural testing of the flanges has shown very promising outcomes. This work was carried out in collaboration with MOOG Dublin.

B. Aldwell, R. Wall (MOOG), A. Amaldi (ESA), **R.Lupoi**, *Machinability of Al 6061 Deposited with Cold Spray Additive Manufacturing*, accepted in the *International Journal of Thermal Spray* as invited article, 2017.

#### 5- Dr. Lupoi pioneers 3D Printing of diamond composites at fast rates

Diamond is a material of great interest, due to exceptional mechanical properties to include very high thermal conductivity. The recent and fast development of 3D printing technologies has however failed with the processing of this material for large geometries, required in several applications in engineering. When high temperatures are used such as in laser based AM, diamond can turn into graphite. Dr. Lupoi was the first to have developed a methodology capable of producing thick (>3mm) diamond composite structures (diamond/Cu) in a cold manner and at fast build rates, hence with properties fully preserved. The structures would also measure a very high content of diamond (>70% in volume); this is a world record for a metal-composite of this kind.



The impact of this has been high. Apart from papers in high rank journals, this work has generated an invention disclosure (see Innovation Activity section) and a follow-on patent application submission. This methodology has the potential to revolutionise the design of thermal management devices, aiming at 2-phase heat transfer nucleation boiling. Preliminary tests carried out in Lupoi and Robinson's labs in TCD have shown an outstanding thermal performance when compared to current solutions.

Shuo Yin, Yingchun Xie, Jan Cizek, Emmanuel Ekoi, Tanvir Hussain, Denis Dowling, **Rocco Lupoi**, *Advanced diamond-reinforced metal matrix composites via cold spray: Properties and deposition mechanism*, *Composites Part B: Engineering*, 2017.


Barry Aldwell, Shuo Yin, Kevin A. McDonnell, Daniel Trimble, Tanvir Hussain, **Rocco Lupoi**, *A novel method for metal-diamond composite coating deposition with cold spray and formation mechanism*, *Scripta Materialia*, 2016.



## A: Selected Senior-Author publications

Shuo Yin, Yingchun Xie, Jan Cizek, Emmanuel Ekoi, Tanvir Hussain, Denis Dowling, **Rocco Lupoi**, Advanced diamond-reinforced metal matrix composites via cold spray: Properties and deposition mechanism, *Composites Part B: Engineering*, 113, 2017, p44 - 54, Journal Article, PUBLISHED [DOI](#) Google Scholar citations: 26

**R. Lupoi**, Current Design and Performance of Cold Spray Nozzles: Experimental and Numerical Observations on Deposition Efficiency and Particle Velocity, *Surface Engineering*, 30, (5), 2014, p316 - 322, Notes: [This paper is part of a *special issue on Cold Spray technology*], Journal Article, PUBLISHED [TARA - Full Text](#) [DOI](#) Google Scholar citations: 20

 **R. Lupoi**, A. Cockburn, C. Bryan, M. Sparkes, F. Luo and W. O'Neill, Hardfacing steel with nanostructured coatings of Stellite-6 by Supersonic Laser Deposition, *Light: Science & Applications*, 1, (1), 2012, p1 - 6, Notes: [This is a journal part of the Nature Publishing Group (NPG)], Journal Article, PUBLISHED [DOI](#) Google Scholar citations: 19

**R. Lupoi** and W. O'Neill, Powder stream characteristics in cold spray nozzles, *Surface and Coating Technology*, 206, (6), 2011, p1069 - 1076, Journal Article, PUBLISHED [TARA - Full Text](#) [DOI](#) Google Scholar citations: 43

**R. Lupoi** and W. O'Neill, Deposition of metallic coatings on polymer surfaces using cold spray, *Surface and Coating Technology*, 205, (7), 2010, p2167 - 2173, Journal Article, PUBLISHED [DOI](#) Google Scholar citations: 95

## B: Other selected Publications

*Note 1:* Dr. Lupoi has currently published **88 peer-reviewed papers** overall, and has established an international cluster of academic co-authors based in Ireland, UK, Italy, France, Czech Republic, China and Canada. He has also published papers with industry partners to include Nammo (IE), EnBio (IE), GE (US) and Siemens (Germany). H-Index: 19. [Funding history](#): ~3.5M€ in the last 4 years.

*Note 2:* The publications listed below and highlighted with an \* at the front refer to senior author papers, as by SFI definition. Dr. Lupoi has submitted an additional 4 journal papers as senior author currently under evaluation.

\*F. Caruso, M.C. Meyer, R. Lupoi, Three dimensional numerical simulations of the particle loading effect on gas flow features for low pressure cold spray applications, *Surface and Coating Technology*, 339, 2018, p181 - 190, Journal Article, [DOI](#)

\*R. Lupoi, T. Lupton, R. Jenkins, A.J. Robinson, G.E. O'Donnell, Direct manufacturing of diamond composite coatings onto silicon wafers and heat transfer performance, *CIRP Annals - Manufacturing Technology*, 2018, Journal Article, [DOI](#)

\*Shuo Yin, Emmanuel J. Ekoi, Thomas L. Lupton, Denis P. Dowling, **Rocco Lupoi**, Cold spraying of WC-Co-Ni coatings using porous WC-17Co powders: Formation mechanism, microstructure characterization and tribological performance, *Materials & Design*, 2017, Journal Article, [DOI](#)

\*Shuo Yin, Zhao Zhang, Emmanuel J. Ekoi, Jing Jing Wang, Denis P. Dowling, Valeria Nicolosi, **Rocco Lupoi**, Novel cold spray for fabricating graphene-reinforced metal matrix composites, *Materials Letters*, 196, 2017, p172 - 175, Journal Article, PUBLISHED [DOI](#)

\*M.Meyer, S.Yin and **R.Lupoi**, Particle In-Flight Velocity and Dispersion Measurements at Increasing Particle Feed Rates in Cold Spray, *Journal of Thermal Spray Technology*, 26, (1), 2017, p60 - 70, Notes: [Invited Paper], Journal Article, PUBLISHED [DOI](#)

\*Barry Aldwell, Daniel Trimble, Shuo Yin and **Rocco Lupoi**, Enabling diamond deposition with Cold Spray through the coated particle method, *Materials Science Forum*, 879, 2017, p1194 - 1199, Journal Article, PUBLISHED [DOI](#)

\*G. Benenati and **R. Lupoi**, Development of a deposition strategy in Cold Spray for Additive Manufacturing to minimize residual stresses, *Procedia CIRP*, 55, 2016, p101 - 108, Journal Article, PUBLISHED [TARA - Full Text](#) [DOI](#)

\*C. Stenson, K. A. McDonnell, S. Yin, B. Aldwell, M. Meyer, D.P. Dowling and **R. Lupoi**, Cold Spray deposition to prevent fouling of polymer surfaces, *Surface Engineering*, 2016, p1 - 11, *Notes: [Received 13 Jul 2016, Accepted 17 Aug 2016, Published online: 17 Sep 2016]*, Journal Article, PUBLISHED [DOI](#)

R. Jenkins, **R. Lupoi**, R. Kempers, A.J. Robinson, Heat Transfer Performance of Boiling Jet Array Impingement on Micro-Grooved Surfaces, *Experimental Thermal and Fluid Science*, 80, 2016, p293 - 304, Journal Article, PUBLISHED [DOI](#)

\*Yingchun Xie, Shuo Yin, Chaoyue Chen, Marie-Pierre Planche, Hanlin Liao, **Rocco Lupoi**, New insights into the coating/substrate interfacial bonding mechanism in cold spray, *Scripta Materialia*, 125, 2016, p1 - 4, Journal Article, PUBLISHED [DOI](#)

\*M.C. Meyer, S. Yin, K.A. McDonnell, O. Stier, **R. Lupoi**, Feed rate effect on particulate acceleration in Cold Spray under low stagnation pressure conditions, *Surface and Coatings Technology*, 304, 2016, p237 - 245, Journal Article, PUBLISHED [DOI](#)

R. Jenkins, C. De Brún, R. Kempers, **R Lupoi**, A. J. Robinson, Thermal-hydraulic performance of convective boiling jet array impingement , 745, 2016, p1 - 10, *Notes: [in connection with the 7th European Thermal-Sciences Conference held in Krakow, Poland]*, Journal Article, PUBLISHED [TARA - Full Text](#) [DOI](#)

Ildiko Peter, Barry Aldwell, **Rocco Lupoi**, Mario Rosso, The deposition of pure aluminium via cold spray for the corrosion protection of steel, *International Thermal Spray Conference (ITSC)*, 324, 2016, pp962 - 967, Conference Paper, PUBLISHED [TARA - Full Text](#)

\*Shuo Yin, Barry Aldwell and **Rocco Lupoi**, Advanced diamond-reinforced copper composite coatings via cold spray and material characterization, *International Thermal Spray Conference (ITSC)*, 324, 2016, pp305 - 309, Conference Paper, PUBLISHED [TARA - Full Text](#)

\*M. Meyer, S. Yin and **R. Lupoi**, Particle in-flight velocity and dispersion measurements at increasing particle feed rates in Cold Spray, *International Thermal Spray Conference (ITSC)*, 324, 2016, pp37 - 42, Conference Paper, PUBLISHED [TARA - Full Text](#)

\***R. Lupoi**, C. Stenson, K. A. McDonnell, D.P. Dowling, E. Ahearne , Antifouling coatings made with Cold Spray onto polymers: process characterization , *CIRP Annals - Manufacturing Technology*, 65, (1), 2016, p545 - 548, *Notes: [The CIRP Annals is the highest rank Journal in Manufacturing and Machining (Google Scholar)]*, Journal Article, PUBLISHED [DOI](#)

\*Shuo Yin, Morten Meyer, Wenya Li, Hanlin Liao, and **Rocco Lupoi**, Gas Flow, Particle Acceleration, and Heat Transfer in Cold Spraying, *Journal of Thermal Spray Technology*, 2016, p1 - 23, Journal Article, PUBLISHED [DOI](#)

\*Chaoyue Chen, Yingchun Xie, Shuo Yin, Marie-Pierre Planche, Sihao Deng, **Rocco Lupoi**, Hanlin Liao, Evaluation of the interfacial bonding between particles and substrate in angular cold spray, *Materials Letters*, 173, 2016, p76 - 79, Journal Article, PUBLISHED [DOI](#)

\*Barry Aldwell, Shuo Yin, Kevin A. McDonnell, Daniel Trimble, Tanvir Hussain, **Rocco Lupoi**, A novel method for metal-diamond composite coating deposition with cold spray and formation mechanism, *Scripta Materialia*, 115, 2016, p10 - 13, Journal Article, PUBLISHED [DOI](#)

\*C. Stenson, M.C. Meyer, B. Twomey and **R. Lupoi**, Particle speed analysis in CoBlast, *CIRP Procedia*, 37, 2015, 77-82, Journal Article, PUBLISHED [DOI](#)

\*R. Bouttier, G. Lopes, L. Clarke and **R. Lupoi**, UREAD impact behaviour using Non-Newtonian materials, *International Journal of Mechanical Engineering and Applications*, 3, (4), 2015, p57 - 62, Journal Article, PUBLISHED

Shuo Yin, Xinkun Suo, Yingchun Xie, Wenya Li, **Rocco Lupoi**, Hanlin Liao Enhanced coating-substrate interfacial bonding by high-temperature substrate, *Journal of Materials Science*, 50, 2015, 7448-7457, Journal Article, PUBLISHED [DOI](#)

\*M.C. Meyer and **R. Lupoi**, AN ANALYSIS OF THE PARTICULATE FLOW IN COLD SPRAY NOZZLES, *Mechanical Sciences*, 6, 2015, p127 - 136, Journal Article, PUBLISHED [DOI](#)

\*Cold Spray in, editor(s)Prof. Luc Laperriere; Prof. Gunther Reinhart , CIRP Encyclopedia of Production Engineering, 2015, pp1 - 4, [**R. Lupoi**], Book Chapter, PUBLISHED [DOI](#)

Fang LUO , Andrew COCKBURN, Martin SPARKES , **Rocco LUPOI** , Zhi-jun CHEN, William O'NEILL, Jian-hua YAO, Rong LIU, Performance characterization of Ni60-WC coating on steel processed with supersonic laser deposition, Defence Technology, 11, 2015, p35 - 47, Journal Article, PUBLISHED [DOI](#)

M. Jones, A.Cockburn, **R.Lupoi**, M.Sparkes, W.O'Neill, Solid-state manufacturing of tungsten deposits onto molybdenum substrates with supersonic laser deposition, Materials Letters, 134, 2014, p295 - 297, Journal Article, PUBLISHED [TARA - Full Text](#) [DOI](#)

\*M. Meyer, **R. Lupoi**, COMPUTATIONAL PREDICTION OF COLD SPRAY NOZZLE PERFORMANCE FOR THE DEPOSITION OF TITANIUM, 31st International Manufacturing Conference (IMC31), Cork (Ireland), 3rd of September, 2014, pp107 - 112, Conference Paper, PUBLISHED [TARA - Full Text](#)

\*M. Jones, A. Cockburn, M. Sparkes , W. O'Neill and **R. Lupoi**, Supersonic Laser Deposition of Tungsten, ASME 2014 Manufacturing Science and Engineering Conference (MSEC 2014), Detroit, USA, 9-13 June, 2014, pp1 - 4, Conference Paper, ACCEPTED [TARA - Full Text](#) [DOI](#)

LUO Fang, **Lupoi Rocco**, Cockburn Andrew, Sparkes Martin, O'Neill William, YAO Jian-hua, Characteristics of Stellite 6 Deposited by Supersonic Laser Deposition Under Optimized Parameters, JOURNAL OF IRON AND STEEL RESEARCH, INTERNATIONAL, 20, (2), 2013, p52 - 57, Journal Article, PUBLISHED [DOI](#)

F. Luo, A.Cockburn, **R.Lupoi**, M. Sparkes, W.O'Neill, Performance comparison of Stellite 6 deposited on steel using supersonic laser deposition and laser cladding, Surface and Coating Technology, 212, 2012, p119 - 127, Journal Article, PUBLISHED [DOI](#)

\***R. Lupoi** and W.O' Neill , An investigation on powder stream in Cold Gas Spray (CGS) nozzles, CFD-ECCOMAS , Lisbon (Portugal), 2011, pp1 - 12, Conference Paper, PUBLISHED [TARA - Full Text](#)

\***R. Lupoi**, A. Cockburn, M. Sparkes, C. Bryan, F. Luo and W. O'Neill , Hardfacing engineering surfaces with Supersonic Laser Deposition of Stellite-6, International Congress on Applications of Lasers & Electro-Optics (ICALEO), Orlando (US), 2011, pp345 - 441, Conference Paper, PUBLISHED [TARA - Full Text](#) [URL](#)

\*F. Osman and **R.Lupoi**, Application of UREAD for the energy dissipation in engineering structures, Key-Engineering Materials, 486, 2011, p1 - 4, Journal Article, PUBLISHED [DOI](#)

\***R. Lupoi**, M.Sparkes, A.Cockburn and W. O'Neill , High speed titanium coating by Supersonic Laser Deposition, Materials Letters, 65, 2011, p3205 - 3207, Journal Article, PUBLISHED [TARA - Full Text](#) [DOI](#)

\*Computational and Strain Gradient Plasticity in, editor(s)Akhtar S. Khan and Babak Farrokh , Finite Plasticity and Visco-plasticity of Conventional and Emerging Materials, Maryland (US), Neat Press, 2010, pp259 - 261, [**R.Lupoi** and F.Osman], *Notes: [ISBN: 0-9659463-2-0]*, Book Chapter, PUBLISHED

\***R. Lupoi** and F.Osman , Investigation into channel angular extrusion and the UREAD energy absorption technique, International Journal of Mechanical Sciences , 50, (5), 2008, p966 - 973, Journal Article, PUBLISHED [TARA - Full Text](#) [DOI](#)

\***R.Lupoi** and F.Osman, A new Approach for experimental evaluation of contact stresses, AMPT 2005, Wisla (Poland), 2005, pp1 - 4, Notes: [**KEYNOTE**], Conference Paper (peer-reviewed), PUBLISHED

\***R.Lupoi** and F.Osman, Under surface pressure sensing technique for the evaluation of contact stresses, Journal of Material Processing Technology, 164-165, 2005, p1537 - 1543, Journal Article, PUBLISHED [DOI](#)