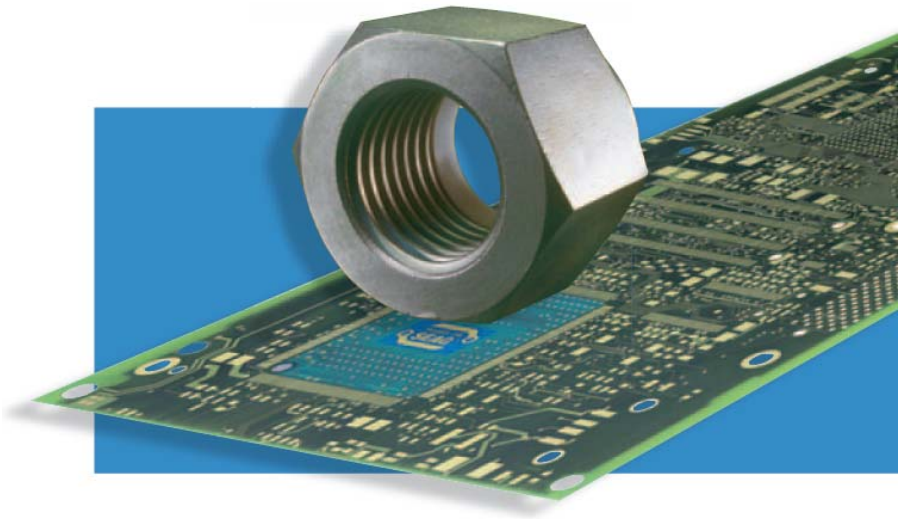
New Ionic Liquid Solvent Technology to Transform Metal Finishing

Application of Ionic Liquids in Plating Technology

3rd Industrial Workshop



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www.ionmet.org

DGO

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Preface

New Ionic Liquid Solvent Technology to Transform Metal Finishing Products and Processes' (IONMET) is the title of a four-year integrated project with 33 partners mainly SME's but also higher education, research institutions, trade associations and large indutrial companies.

The overall objective of the project is the introduction of a breakthrough technology with the potential to transform the scope and competitiveness of industrial metal finishing processes. The new technology will introduce a novel generic group of ionic liquid solvents which will provide the tools to significantly transform the innovative capability of the huge number of traditional manufacturing SME's involved directly in the surface finishing and printed circuit board manufacturing industry sectors in particular. The radical new generic technology will enable the introduction of a large number of totally new products and processes, which cannot be produced using existing technology.

This project will significantly accelerate the opportunity to commercialise the use of ionic liquids in the metal finishing industry.

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Programm

Chair: Dr. U. König

10:30 Registration & Coffee

10:45 Welcome and Overview of IONMET
Dr. K. Shukri, Genacys Ltd

Session 1 Application in Plating

11:00 Aluminium Electroplating in Ionic Liquids
K. Ryder, University of Leicester

11:30 Chrome Plating from Cr(III) in Ionic Liquids
P. Benaben, M. Boudes, Y. Garnier, Ecole des Mines

12:00 Electropolishing in Ionic Liquids
J. Collins, C-Tech Innovation Ltd

12:30 PCB Surface Finish Application
E. Smith, University of Leicester

13:00 Lunch

Session 2 Handling of Ionic Liquids

14:00 Environmental Aspects
U. Izagirre, INASMET-Tecnalia

14:30 Recycling and Waste Management
E. Matthijs, KaHo Sint-Lieven

15:00 Handling of IL –Technology in Production
A. Möbius, C. Werner, Enthone GmbH

15:30 Ionic Liquids: Overview on commercial applications and first toxicological assessments
Dr. U. Vagt, A. Alemany, BASF SE

16:00 End of Meeting, Discussion & Coffee

Welcome and Overview of IONMET

Dr. K. Shukri
Genacys Ltd

An overview of the IONMET project including size, distribution of partners and the running of the project. Also a summary of project objectives and achievements including developing seven technologies and build and commissioning of five commercial pilot plants.

Aluminium Electroplating in Ionic Liquids

Dr. K. Ryder
University of Leicester, UK

Chrome Plating from Cr(III) in Ionic Liquids

P. Benaben, M. Boudes, Y. Garnier
Ecole Nationale Superieure des Mines – Saint-Etienne – France
Benaben@emse.fr

As substitute for hard chromium deposition from hexavalent solution (chromic acid), electro-deposition of chromium metal from trivalent salts is a large research field since many years. To overcome the difficulties of this substitution, programs in USA, Japan and Europe have been developed. But until now no processes have been industrially developed.

Since 4 years, a large European program (FP6-2003-NMP-SME-3) named “New Ionic Solvent Technology to Transform Metal Finishing Products and Processes” (Acronym IONMET) is developed by more than 30 partners. Non-aqueous solutions allow to obtain electrochemical reactions completely different from electrochemical reactions in aqueous media: results have shown that it is possible to deposit “exotic” metals, generally impossible due to aqueous reactions (cf. Pourbaix diagrams).

During the IONMET program, hard chromium plating process using ionic liquid has been developed. We will present the results obtained during the program in particular on electrochemical, structural and functional aspects. As results, it is possible with a Faraday efficiency between 25 to 30%, to deposit chromium layers, with a hardness of about 700 Hv/100g which increases to about 1500 Hv/100g after heat treatment (as general chromium layers obtained using Cr(III)). Deposition of Composite Chromium layers will be also described.

The future of the process will be envisaged and some aspects of the implementation in a pilot plant will be described.

Electropolishing in Ionic Liquids

J. Collins
C-Tech Innovation Ltd, UK

PCB Surface Finish Application

E. Smith
University of Leicester, UK

Environmental Aspects

Usoa Izagirre
INASMET-Tecnalia, Spain

Environmental risk analysis and implications in health & safety were analysed at INASMET-Tecnalia for the Hard Chrome plating process from CrIII in Ionic Liquids developed within the scope of the Ionmet project. The ionic liquid plating electrolyte is basically composed of choline chloride and chromium trichloride mixtures. Analysis of the gas emissions and of the exhausted electroplating bath showed degradation of the organic compound (TOC and chloride decrease) and Cr and Cl emissions. In order to have toxicological and ecotoxicological information about the referred ionic liquid, several tests were also carried out reaching the following conclusions: the ionic liquid is not toxic and not harmful on dermal or oral via; it is not irritant for the skin but it is irritant for the eyes; it is not mutagenic at low concentrations but, due to its citotoxicity, it can not be confirmed if it is at high concentrations; according to the vibrio fisheri tests the liquid is very toxic; the daphnia magna test classifies it as harmful to aquatic organisms; it is not readily degradable. Finally, a comparison with traditional Hard Chrome plating baths (sulphuric acid and chromium trioxide solutions in water) is presented, where the CrIII-ionic liquid formulations shows to be “greener” than the traditional CrVI baths.

Recycling and Waste Management

E. Matthijs
KaHo Sint-Lieven, Belgium

The use of ionic liquids as a solvent makes possible the electrodeposition of metals which can impossibly be deposited when water is present. However, other problems emerge just because of the absence of water.

In this presentation some important questions that arise when the complete galvanic process is considered, are discussed. For example, one can wonder what reaction occurs at the anode or what ‘s the best way to compensate drag-out of process solution. The latter is related with the question which solvents should be used in pretreatment and rinsing steps; when water is used the risk is high it will be carried over in the process solutions. Furthermore, some possible ways to tackle these problems are discussed. The use of online recycling techniques and acceptable ways to treat rejected ionic liquid solutions are evaluated.

Handling of IL –Technology in Production

A. Möbius and C. Werner
Enthone GmbH, Langenfeld, Germany

In the last few years a new generation of electrolytes became fashion at scientific groups all over the world. These electrolytes are called: Ionic Liquids. An ionic liquid is a liquid that contains essentially only ions and usually show melting points below 100°C and having low vapour pressure. Some ionic liquids have an electrochemical window of 3-5 Volts which make them attractive for plating processes (such as chromium, aluminium, magnesium and others). A lot of scientific groups are working in this field and developed several electrolyte systems. The “IONMET” project funded by the EU use choline chloride based electrolytes. Some of the formulations contain water from added metal salt hydrates.

However it turns out that the common technology that is used for industrial plating is not the right way for application. Ionic liquids are – even if they are being produced in industrial scale – rather expensive and have a certain value. Additionally there is usually the need to work under very humidity free conditions because some metal salts are very sensitive against moisture. Therefore plating industry has to supply concepts of sealed reactor technology with optimized and flexible plating cells that can achieve moisture free and closed loop work. An other aspect is that in choline chloride based electrolytes oxidation reaction can occur at inert anodes. That could be chlorine evolution.

The presentation will show concepts that allow to use this fascinating new generation of electrolytes, it shows the challenges and risks but also the opportunities.

Ionic Liquids:
Overview on commercial applications and first toxicological assessments

Dr. Uwe Vagt, Aurelie Alemany
BASF SE, Ludwigshafen / D

Ionic Liquids have gained overwhelming interest over the past years. Today they are discussed as a valuable alternative in many commercial processes and products, because they open up the way to novel solutions not achievable with any other material.

The lecture will first give an overview on applications utilizing Ionic Liquids, which are already commercialized or are close to commercialization from BASF’s perspective. The unique combination of properties has opened up a broad range of applications where Ionic Liquids bring significant improvements to products and processes.

Parallel to the development of products and processes, the impact of Ionic Liquids on the environment and man needs to be carefully investigated. Therefore the second part of the lecture will focus on relevant exposure scenarios related to the intended applications and what kind of experimental data from BASF’s point of view are necessary to assure safe handling and use of Ionic Liquids. Furthermore first ecological and toxicological findings will be presented and what current and future legal requirements (REACH) need to be fulfilled.

List of participants

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2. Bán, Andreas, VDEh-Betriebsforschungsinstitut, Düsseldorf - D
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4. Böck, Reinhard, FEM Schwäbisch Gmünd - D
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6. Bünger, Paul, MTU Aero Engines GmbH, München - D
7. Cano, Paco, INASMET - E
8. Collins, John, C-Techn Innovation Ltd. - UK
9. Dallaway, Adrian, Anopol Ltd. - UK
10. Dornbusch, Michael, Dörken MKS Systeme, Herdecke - D
11. Eckert, Julia, FhG IPA, Stuttgart - D
12. Fox, Michael, Aluminal Oberflächentechnik, Montabaur - D
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32. Stößer, Gregor, MacDermid GmbH, Forst – D
33. Sven-Erik, Wulf, FEM Schwäbisch Gmünd - D
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35. Vagt, Uwe, BASF SE, Ludwigshafen - D
36. Wheeler, Daniel, Anopol Ltd. - UK

You can get further information at

www.ionmet.org