



INTERNATIONAL HARD
ANODIZING ASSOCIATION

18th Technical Symposium

Sept. 21 - 23, 2022

Copenhagen

DENMARK

OVERVIEW

About IHAA

The International Hard Anodizing Association was formed in 1989 and is an organization of companies engaged in the production of hard anodized finishes on aluminum components, either for customers or for their own products. Other "associate" members may be manufacturers of semi-fabricated aluminum, companies engaged in supplying chemicals and processes or plant and equipment to the hard-anodizing industry, or companies which are users of hard anodized components and products but do not have their own anodizing facility.

Symposium Overview

Users of aluminum, hard anodizing companies and researchers will meet in Copenhagen in the fall of 2022 to discuss the latest trends and solutions for the aluminum surface treatment industry. The bi-annual technical symposium is an event for anyone who uses aluminum for technical applications. Our comprehensive symposium includes an opening-night cocktail reception and dinner, plus two full days of scientific and process-related presentations with a focus on functional oxide layers on aluminum parts. In addition to the technical presentations, a variety of networking activities are arranged to continue discussions with colleagues.

SCHEDULE AT-A-GLANCE

WEDNESDAY, SEPTEMBER 21, 2022

6:00 p.m. – 7:00 p.m. Cocktail Reception at the Phoenix Hotel

7:00 p.m. – 10:00 p.m. Opening Dinner at the Phoenix Hotel

THURSDAY, SEPTEMBER 22, 2022

9:00 a.m. – 10:00 a.m. Registration & Breakfast

10:00 a.m. – 10:10 a.m. Opening Remarks
Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark

Pretreatment/Sealing of Hard Coat

10:10 a.m. – 10:50 a.m. Effect of Pretreatment on Appearance of Anodic Coating
Presented by Tej Patel, Techevon – Chicago, Illinois, U.S.A.

10:50 a.m. – 11:30 a.m. Microstructure analysis and corrosion resistance of anodic alumina films after sealing in solutions including metal
Presented by Prof. Sachiko Ono, Kogakuin University – Tokyo, Japan

11:30 a.m. – 11:50 a.m. Break

Issues with Hard Coat

11:50 a.m. – 12:30 p.m. The Effect of Anodization and Impregnation on Corrosion Fatigue Properties of 2024 Aluminum Alloy Used for Prosthesis
Presented by Asger Gade Andersen, Aluline – Tølløse, Denmark

12:30 p.m. – 1:30 p.m. Lunch

1:30 p.m. – 2:10 p.m. Engineering Considerations for Difficult Alloy Anodizing
Presented by Peter Totaro, Master Metal Finishing – Paterson, New Jersey, U.S.A.

2:10 p.m. – 2:50 p.m. Crazing/Cracking - What Internal Stresses are Introducing this Phenomenon
Presented by Anne Deacon Juhl, AluConsult – Denmark

2:50 p.m. – 3:10 p.m. Break

Other Coatings and New Technologies

3:10 p.m. – 3:50 p.m. Selective Anodization
Presented by Frédéric Cours, Aalberts Surface Treatment GmbH, Germany

3:50 p.m. – 4:30 p.m. G.H.A. - Multifunctional Hard Anodizing with Silver Ions
Presented by Alessandro Savelli & Costantino Cicerchia, G.H.A. Europe s.r.l., Italy

4:30 p.m. – 4:45 p.m. Closing Remarks
Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark

SCHEDULE AT-A-GLANCE

FRIDAY, SEPTEMBER 23, 2022

- 8:30 a.m. – 8:50 a.m. **Breakfast**
- 8:50 a.m. – 9:00 a.m. **Opening Remarks**
Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark
- Other Coatings and New Technologies*
- 9:00 a.m. – 9:40 a.m. **Coatings made by Physical Vapour Deposition: Possibilities, Limitations and the How to Deposit Aluminium Coatings Suitable for an Anodizing**
Presented by Kristian Rechendorff, Tribology Centre, Danish Technological Institute – Aarhus, Denmark
- 9:40 a.m. – 10:20 a.m. **Introduction of Lubrication Anodic Film, Kashima-Coat**
Presented by Hitoshi Kawai and Mitsuka Shimano, Kashimacoating – Japan
- 10:20 a.m. – 10:40 a.m. **Break**
- 10:40 a.m. – 11:20 a.m. **Anodic Aluminium Oxide-based Creation of Metallic Nano-and Microstructures and Carbon Nanotubes, and Some Potential and Current Applications**
Presented by Professor Per Morgen, Mion Technology, and University of Southern Denmark – Odense, Denmark
- 11:20 a.m. – 12:00 p.m. **Anodising of Additive Manufactured Aluminium-Silicon Alloys**
Presented by Professor Iris De Graeve, Vrije Universiteit Brussel – Belgium
- 12:00 p.m. – 1:00 p.m. **Lunch**
- Standards and Certifications*
- 1:00 p.m. – 1:40 p.m. **MIL-PRF-8625 Thoughts, Views, Comments – and Why a New Revision Was Planned**
Watch for speaker information soon!
- 1:40 p.m. – 2:20 p.m. **QUALANOD – Quality Label for Sulfuric Acid-Based Anodizing of Aluminum**
Presented by Robin Furneaux – Oxfordshire, UK
- 2:20 p.m. – 2:40 p.m. **Break**
- 2:40 p.m. – 3:20 p.m. **ISO 10074 – International Specification for Hard Anodic Oxidation Coatings on Aluminum and Its Alloys**
Presented by Robin Furneaux – Oxfordshire, UK
- 3:20 p.m. – 4:00 p.m. **The Meaning of a Quality Seal: Hard and Functional Anodizing**
Presented by Dieter Brodella, ALCON – Germany
- 4:00 p.m. – 4:20 p.m. **Closing Remarks**
Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark
- 4:30 p.m. – 5:30 p.m. **IHAA Members Meeting**
- 5:30 p.m. – 6:00 p.m. **IHAA Board of Directors Meeting**

SCHEDULE DETAILS

WEDNESDAY, SEPTEMBER 21, 2022

6:00 p.m. – 7:00 p.m. Cocktail Reception at the Phoenix Hotel

7:00 p.m. – 10:00 p.m. Opening Dinner at the Phoenix Hotel

THURSDAY, SEPTEMBER 22, 2022

9:00 a.m. – 10:00 a.m. Registration & Breakfast

10:00 a.m. – 10:10 a.m. Opening Remarks
Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark

Pretreatment/Sealing of Hard Coat

10:10 a.m. – 10:50 a.m. **Effect of Pretreatment on Appearance of Anodic Coating**

Presented by Tej Patel, Techevon – Chicago, Illinois, U.S.A.



This presentation will discuss the pretreatment possibilities for aluminum prior to anodizing and the effect on color. Different methods of mechanical as well as chemical pretreatments will be considered and their effect on color will be reviewed using visual observations as well as spectral analysis using a Spectrophotometer. Furthermore, the effect of anodizing current density will also be reviewed as it relates to product appearance.

Tej has over 15 years of consulting and industry experience specializing in the areas of supply chain, operations improvement, and manufacturing. Prior to joining Techevon, he was a Vice President at AlixPartners, a leading global consulting firm. As part of the supply chain and operations practice, he led several cost savings and efficiency initiatives among a variety of manufacturers. Additionally, Tej has held positions at Baxter Inc., a Fortune 150 medical products manufacturer, and Archstone Consulting. While at Archstone Consulting, he led multiple client teams and projects in the areas of plant floor operations, LEAN manufacturing, and supply chain improvements across several industries. Tej holds an MBA from the Kellogg School of Management, with concentrations in Operations, Strategy, and Marketing in addition to a Bachelor's Degree in Biomedical Engineering from Northwestern University.

10:50 a.m. – 11:30 a.m. **Microstructure analysis and corrosion resistance of anodic alumina films after sealing in solutions including metal**

Presented by Prof. Sachiko Ono, Kogakuin University – Tokyo, Japan



Microstructural changes in anodic alumina films after various types of sealing treatments such as boiling water, nickel acetate sealing, and lithium hydroxide room temperature sealing were analyzed using state-of-the-art TEM, SEM, and EDS to evaluate corrosion resistance.

She received her PhD degree from the University of Tokyo and became a full professor at Kogakuin University in 2002. Currently, she is a professor emerita and visiting researcher at Kogakuin University and a visiting professor at Kanto-Gakuin University. She has served as a counselor and chairperson of academic committees of several domestic academic societies, including the Anodizing Research Society of Japan. She specializes in applied physical chemistry, electrochemistry, surface chemistry, and functional materials.

11:30 a.m. – 11:50 a.m. Break

Issues with Hard Coat

11:50 a.m. – 12:30 p.m.

The Effect of Anodization and Impregnation on Corrosion Fatigue Properties of 2024 Aluminum Alloy Used for Prosthesis

Presented by Asger Gade Andersen, Aluline – Tølløse, Denmark



Many structural parts of a lower limb prosthetic are manufactured from 2000 series aluminum due to the high strength to weight ratio. In order to improve corrosion and wear properties, the parts are anodized in sulphuric acid (SAA). Hard anodizing can further improve wear properties of an anodized part. However, anodization is known to cause a fatigue debit as intermetallic particles are dissolved and leave porosities during the anodization process, which acts as crack initiation points. The first half of this presentation focuses on understanding if semi hard anodized (SHA) parts have similar fatigue and corrosion fatigue properties SAA parts. The second part of this presentation will introduce a method for impregnating HA parts with polyethylene (PE) wax to improve fatigue and corrosion fatigue properties.

Asger Gade Andersen has conducted an industrial Ph.D. in collaboration with Aluline A/S and the Technical University of Denmark. During the Ph.D. he developed a coating method for improving wear, corrosion and fatigue properties of aluminum, with particular application for the prosthetic industry.

12:30 p.m. – 1:30 p.m.

Lunch

1:30 p.m. – 2:10 p.m.

Engineering Considerations for Difficult Alloy Anodizing

Presented by Peter Totaro, Master Metal Finishing – Paterson, New Jersey, U.S.A.



Wrought aluminum alloys can significantly increase the complexity of the anodization reaction due to their heterogeneity in the surface matrix. This presentation highlights the negative effects of the anodization reaction and the practical steps taken to mitigate these issues in an industrial setting. Some topics to be discuss are theory/background, defective coating identification, up-front engineering, racking, electrolyte considerations, other state variable considerations, and equipment modifications.

Peter Totaro is the Vice President of Operations and head of Engineering at Aerotech Processing Solutions. Aerotech is in New Jersey, USA, about a 30-minute drive from New York City. Aerotech is a NADCAP certified aerospace processing firm who provides Types 1,2,3 anodizing, chemical conversion, passivate, electroless nickel, NDT, and painting. Aerotech has grown to be an industry leader in both quality and performance of the products it manufactures. Peter has recently joined the Almax Products team as the Technical Director and minority owner. He helps troubleshoot and consult on electrochemical processes, equipment implementation, and all aspects of EHS. He also trains personnel in laboratory best practices. Almax Products provides manufacturing equipment and consumables for all areas of manufacturing with an emphasis on plating and material handling equipment. Peter recently graduated with a PhD in chemical engineering at the New Jersey Institute of Technology. The focus of his research was the Effect of Current Density Ramping on the Anodic Reaction and Morphology of Aerospace Aluminum Alloys. Peter has published papers in journals Surface and Coatings Technology and Materials.

2:10 p.m. – 2:50 p.m.

Crazing/Cracking - What Internal Stresses are Introducing this Phenomenon

Presented by Anne Deacon Juhl, AluConsult – Denmark



This presentation will take a look into the various situations which can cause crazing/cracking of hard anodic coatings. It will also try to see if there is a distinction between crazing and cracking of an aluminum oxide layer. The tendency to crazing increases as the hardness of the anodic coating increases, that is a known fact but is it because of alloy, sealing method, thickness, or anodizing parameters. This will be some of the thoughts which will be elaborated during the presentation. The major cause for the cracking/crazing is for sure the difference in the coefficient of thermal expansion between the

oxide coatings and the aluminum substrate. What also influence the appearance of this fine network across the surface will be tried to be illustrated using literature and experience. How this phenomenon influences on the final properties of the coating will be a part too giving some examples from real life.

Anne Deacon Juhl did a PhD in pulse anodizing at the Technical University of Denmark. During this period, she established a personal network in Europe, the U.S., and Scandinavia. As a consultant within the field of finishing of aluminum she has worked with all different kinds of chemical and electrochemical surface treatments, such as anodizing, coatings, electroplating, and electroless plating having 25 years of experience in the industry. Working as a consultant in AluConsult helping people to understand the common mistakes, pitfalls and challenges when working with anodizing or parts to be anodized. At Anodizing School her practical and theoretical knowledge is transformed into actionable steps that helps anodizing companies around the world to improve their anodizing line.

2:50 p.m. – 3:10 p.m.

Break

Other Coatings and New Technologies

3:10 p.m. – 3:50 p.m.

Selective Anodization

Presented by Frédéric Cours, Aalberts Surface Treatment GmbH, Germany



Presentation of the Selga Coat® Technology with examples of more challenging customers' requirements. Selga Coat® : a sustainable process and comparison Co2 footprint with the bath anodizing.

Since 2015, technical manager at Aalberts Surface Technologies, Faulquemont, France responsible of the development of machine and tools for selective coating technical support for strategic customers training of customers in selective surface treatment technology.

3:50 p.m. – 4:30 p.m.

G.H.A. - Multifunctional Hard Anodizing with Silver Ions

Presented by Alessandro Savelli & Costantino Cicerchia, G.H.A. Europe s.r.l., Italy



Silver ions in the ceramic layer grants notable benefits: technological properties such as Anticorrosion, Antiwear and Dry sliding behavior besides Antibacterial, Antiviral and Antialgae, set the GHA at the top of the technologies available for every industrial application as well as the healthy living world.

Alessandro Savelli is a founding partner of GHA Europe and as a technical director he's been working to industrialize this technology which has become one of the most successful in the pharma and food packaging industry.



Costantino Cicerchia -is a GHA Mechanical Engineer. He's following the metallurgical development activity in the company and researching for new technical and business possibilities.

4:30 p.m. – 4:45 p.m.

Closing Remarks

Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark

FRIDAY, SEPTEMBER 23, 2022

8:30 a.m. – 8:50 a.m.

Breakfast

8:50 a.m. – 9:00 a.m.

Opening Remarks

Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark

Other Coatings and New Technologies

9:00 a.m. – 9:40 a.m.

Coatings made by Physical Vapour Deposition: Possibilities, Limitations and the How to Deposit Aluminium Coatings Suitable for an Anodizing

Presented by Kristian Rechendorff, Tribology Centre, Danish Technological Institute – Aarhus, Denmark



Physical Vapour Deposition (PVD) is a family of versatile and commonly used vacuum techniques for production of thin hard coatings. These coatings are used in a wealth of applications where the aim could be to improve wear resistance of a tool, reduce friction between parts, obtain special optical or electrical properties of a component etc. In this talk focus will be on a particular deposition technique, called sputter deposition.

The talk is divided in four parts: Introduction to PVD coatings; basics of the sputter deposition technique; characteristics and use of the coatings grown by sputter deposition; and a case of deposition of aluminum for anodizing.

In the first part of the talk, PVD coatings will be introduced in general, describing some commonly used application and coating methods. In the second part, focus will be on the technical basics of the sputter deposition technique, with emphasis on possibilities and limitations concerning which samples can be coated. Coating equipment and processes will be discussed.

In the third part, coatings grown by sputter deposition will be described. Sputter deposition allows for a large degree of tuning concerning coating chemistry and coating morphology. These microscopic details (lattice structure and coating morphology) are strongly linked to the macroscopic performance (hardness, friction etc.), and examples of this will be given.



Finally, in the fourth part, cases of deposition of aluminum coatings will be described. Usually, PVD coatings are used without further treatment, however, it is possible to anodize aluminum coatings. It will be shown how the structure and chemistry will strongly affect the anodizing behavior.

Kristian Rechendorff is senior consultant at Danish Technological Institute working with research and development of thin film coatings using PVD. He has been involved in many different projects concerning the use of coatings, including coatings for improved electrical properties for contacts and sensors, easy-release coatings for plastic moulding, and decorative aluminium coatings. He has a background as physicist (phd. from the University of Aarhus) and has worked as a post.doc. (Technical University of Lausanne, Switzerland) in both cases focusing on the interaction of biomolecules with surfaces.

9:40 a.m. – 10:20 a.m.

Introduction of Lubrication Anodic Film, Kashima-Coat

Presented by Hitoshi Kawai and Mitsuka Shimano, Kashima-Coating, – Japan



Kashima-coat is lubricating hard anodize film where Molybdenum is impregnated into hard anodized pores. Kashima-coating is used for Automotive, Motorcycle and Equipment parts. Using Kashima-coat make Bearings and Bushes enhancing wear resistance, therefore it reduces number of parts which makes product lighter weight and reduce the product cost.

Joined working for Miyaki since 1996. In 2012, as president of Miyaki USA Back to Miyaki head office in Japan in 2015. Now as leader of oversea sales group of Miyaki Co., Ltd. in Japan.

10:20 a.m. – 10:40 a.m.

Break

10:40 a.m. – 11:20 a.m.

Anodic Aluminium Oxide-based Creation of Metallic Nano-and Microstructures and Carbon Nanotubes, and Some Potential and Current Applications

Presented by Professor Per Morgen, Mion Technology, and University of Southern Denmark – Odense, Denmark

Anodization of aluminium is first and foremost applied in industry to protect the underlying metal from mechanical and chemical attacks, but also used to accommodate colorants and coatings rooted in the porous nature of the oxide created. We have recently developed various types and forms of "engineered

coatings" on pure and alloyed anodized aluminium such as very powerful optical sensors, and supports for catalysts, with imbedded carbon-nanotubes in the pores, with potential for e-fuel processing, and, most recently, copper coatings for antibacterial and electrical applications, in research reaching back to 2010, but with initial efforts from 1986. A company, Mion Technology, was founded to bring these developments to the marketplace in 2016, in a partnership with The University of Southern Denmark, in Odense, Denmark. Examples of these developments and their applications, and some important findings during the projects, will be given in the presentation.

Per Morgen is currently a professor (assoc.) emeritus in Chemical Engineering, Institute of Green Technology, University of Southern Denmark. Head of research, MION Technology ApS, Børkop, Denmark. Last university position held before retirement: Head of Research, Institute of Physics, Chemistry and Pharmacy, University of Southern Denmark.

11:20 a.m. – 12:00 p.m.

Anodising of Additive Manufactured Aluminium-Silicon Alloys

Presented by Professor Iris De Graeve, Vrije Universiteit Brussel – Belgium



This presentation will show how the anodizing mechanism and anodic oxide structure of powder-based additive manufactured (by SLM-Selective Laser melting) Al-Si alloys is very different than for conventional cast and wrought alloys. The unique fine microstructure of AM aluminum-silicon alloys consists of a near-to-continuous silicon network in the as-built condition, with a connectivity depending on the silicon content. This silicon phase is consuming part of the anodic charge during anodizing and is fully converted into silicon oxide in the anodic film. Heat treatments of the printed alloy disrupts this connected network to an extent depending on the heating temperature and time; this disrupted microstructure in turn also influences the anodizing behavior. Furthermore, AM artifacts in the printed metal, like subsurface pores, create large defects during anodizing, which must be avoided. In conclusion, it is demonstrated that anodizing of AM aluminum is possible, and that the film structure and properties are very unique: just like the AM microstructures, they are far from conventional, but do provide corrosion protection.

Professor in the research group of Electrochemical and Surface Engineering at the Vrije Universiteit Brussel, dealing with surface properties and engineering of metals with long standing track record on various metals, including aluminium, anodising and other surface coatings and treatments for the creation of functional surface properties. Her group was the first to look into the corrosion and anodising mechanisms of additive manufactured aluminium-silicon alloys.

12:00 p.m. – 1:00 p.m.

Lunch

Standards and Certifications

1:00 p.m. – 1:40 p.m.

MIL-PRF-8625 Thoughts, Views, Comments – and Why a New Revision Was Planned
Watch for speaker information soon!

1:40 p.m. – 2:20 p.m.

QUALANOD – Quality Label for Sulfuric Acid-Based Anodizing of Aluminum

Presented by Robin Furneaux – Oxfordshire, UK



The mission of Qualanod is to promote the use and secure the quality of anodized aluminum through the design and management of a product certification scheme adapted to end-market needs. Qualanod's main competencies lie in the areas of anodizing technology and a license system for issuing the quality label. The anodizing technology is that associated with anodizing aluminum and its alloys in solutions based on sulfuric acid and includes all process steps in the anodizing line such as etching, anodizing, colouring and sealing. A key competence is testing the characteristics and performance of anodized aluminum. An important competence involves the license system which Qualanod has established and operates and maintains. The system includes the infrastructure associated with the regular inspection of licensed anodizing plants to verify that they are maintaining compliance with the Qualanod specifications, which is necessary to retain the license.

Now retired, Robin Furneaux was the owner and director at TSC Surface Critical Products Ltd from 2004 to 2018. This was a micro-business providing technical consultancy to industry that was manufacturing or using surface-critical aluminium products or anodic aluminium oxide. From 1978 to 2002, he worked for Alcan at its R&D centre in Banbury, England. He managed projects on the surface treatment and finishing of aluminium rolled products and extrusions. He developed the Anopore® micro- and nanoporous membranes based on anodizing technology. For two years, he was 'product manager - anodizing & bright' for Alcan Rolled Products Europe. Robin has a PhD in corrosion science from the University of Manchester. Currently, he is chair of Qualanod's technical committee and sits on the ISO subcommittee concerned with anodizing standards.

2:20 p.m. – 2:40 p.m.

Break

2:40 p.m. – 3:20 p.m.

ISO 10074 – International Specification for Hard Anodic Oxidation Coatings on Aluminum and Its Alloys

Presented by Robin Furneaux – Oxfordshire, UK



ISO 10074 is the international standard providing a specification for hard anodic oxidation coatings on aluminium and its alloys. It does not have the status of being a European standard (EN) although has been adopted by many individual European countries. It was originally developed in the UK and published as BS 5599 in 1978. It was adopted as an interventional standard in 1994. The most recent modifications have taken place in the last five years. The main characteristics included are coating thickness, surface density, wear resistance, microhardness and corrosion resistance. There is a classification of alloys which is related to test performance criteria. It includes processing guidance but does not specify methods. The main changes that have been implemented in recent years relate to testing for wear (abrasion) resistance.

Now retired, Robin Furneaux was the owner and director at TSC Surface Critical Products Ltd from 2004 to 2018. This was a micro-business providing technical consultancy to industry that was manufacturing or using surface-critical aluminium products or anodic aluminium oxide. From 1978 to 2002, he worked for Alcan at its R&D centre in Banbury, England. He managed projects on the surface treatment and finishing of aluminium rolled products and extrusions. He developed the Anopore® micro- and nanoporous membranes based on anodizing technology. For two years, he was 'product manager - anodizing & bright' for Alcan Rolled Products Europe. Robin has a PhD in corrosion science from the University of Manchester. Currently, he is chair of Qualanod's technical committee and sits on the ISO subcommittee concerned with anodizing standards.

3:20 p.m. – 4:00 p.m.

The Meaning of a Quality Seal: Hard and Functional Anodizing

Presented by Dieter Brodalla, ALCON GmbH – Germany



4:00 p.m. – 4:20 p.m.

Closing Remarks

Jan Rohdemejer, IHAA President, HAI A/S – Horsens, Denmark

4:30 p.m. – 5:30 p.m.

IHAA Members Meeting

5:30 p.m. – 6:00 p.m.

IHAA Board of Directors Meeting