aerospace & advanced composites

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AAC Activities in the Field of Icing

We have been active in the field of icing since 15 years, tackling the problem of icing in different environments and with different methods. Icing is not only a problem in aviation but also in wind energy, solar energy, and in other industrial applications. In this past 15 years, we have developed active and passive methods for anti-icing and de-icing. This are passive anti-icing coatings and active electro thermal and electro expulsive de-icing systems. At the same time we had to improve our own analytical methods to accelerated the development cycle. AAC has an ice adhesion test setup for rapid determination of the static ice adhesion shear force. This is the core tool to get direct feedback in the coating development loop. Recently we have widened our analytical offering, so that now we can perform a TRL 3 assessment of coatings in our lab.

AAC is also exploring new methods of applying chemical finishes on femtosecond laser treated surfaces to produce durable anti-icing coatings.

Furthermore, in more than 8 national and European projects, we have developed a strong partner network in the field of icing. With our partners we can offer upscaling and production of coatings, wind tunnel testing (fixed wing and rotary wing), precise determination accreted ice shapes and mass, and simulation of icing on aircraft.

Anti-Icing and De-Icing Coatings for Aircraft and Wind Energy

Mitigating the impact of Icing through active and passive technologies

AAC is active in the field of icing countermeasures in the form of passive coatings and active heating systems and electromechanical actuators, since 2008.

Coating Development

Passive anti-icing coatings, lower the adhesion of ice to the surface to prevent icing or to support active de-icing and anti-icing systems. In the latter case, the power consumption of the active systems can be reduced. The research of AAC focuses on several paths to reach this goal: lowering the surface energy, formation of a slippery surface (SLIPS) and patterning of surfaces. By this methods, ice adhesion forces lower than 100kPa were already achieved and successfully tested in an icing wind tunnel environment.

Active De-Icing System

Secondly, AAC has developed a conductive coating material for heating of aircraft or windmill leading edges. This heating varnish can be applied onto 3D surfaces. Together with the passive coating, this forms a synergetic system.

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Coating Characterisation

To qualify the coatings, AAC additionally conducts material characterisation. AAC offers a wide spectrum of test facilities for material development and characterization of high standard, some of them regarded as rare and in specific aspects unique. The AAC specializes in the following fields:

- Rapid measurement of ice adhesion shear force
- Determination of water contact angle, roll-off angle and surface energy
- Determination of adhesion to substrate (cross cut. ISO 2409)
- Scratch resistance (ISO 1518)
- Layer thickness (magnetic induction or cross-cut)
- Flexibility (ISO 1519)
- Light and electron microscopy (SEM), together with metallographic sample preparation (embedding and cross-cuts)
- Environmental testing and weathering:
    - QUV test
    - Xenon test
    - Thermal cycling
- Immersion into typical aviation liquids:
    - Hydraulic fluids
    - Solvents
    - De-Icing liquids
    - Water
    - Aqueous cleaners

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List of Anti-Icing Research Projects

AAC has been involved in R&D of anti-ice coatings since 2008 and has successfully participated in more than 8 national and European projects, involving wind park operators (WEB) and aircraft manufacturers (Diamond Aircraft, Airbus).

- 2008: *Anti-Ice*: "Anti-icing/De-icing Systems to improve Aircraft Performance and Safety. Combination of icephobic coatings with piezoelectric de-icing for aircraft."
- 2011: *IceGrid*: "icing and de-icing of restraining grids in the air-conditioning system of passenger aircraft and mobile pre-conditioned air units (PCA-units) is investigated."
- 2012: *Rotorblattenteisung*: "Increased productivity through management of ice build-up on rotor blades. Combination of icephobic coatings with electro thermal heating layers for wind energy applications".
- 2013: *IceDrip*: "Aircraft anti-icing and de-icing through assemblies of conducting varnish and functional coatings. Combination of icephobic coatings with electro thermal heating layers for aircraft leading edge anti-icing and de-icing".
- 2017: *LubRes* "Novel anti-ice surfaces based on lubricant reservoirs in polymer coatings. Development of novel eco-friendly erosion resistant icephobic coatings for aircraft". In this project SLIPS surfaces were prepared and characterised.
- 2020: *JOICE*: "Joint Austrian In-flight Icing Research Venture 2020+". In JOICE AAC is working on a combined anti-icing and de-icing system, utilizing AAC coatings, electro thermal heating and mechanical de-icing. In wind tunnel test, the increase in efficiency of the thermal and mechanical methods by the application of the coatings will be determined (ongoing). A laboratory test plant to measure the ice adhesion shear force was Link
- 2020: *IMPACT*: "AIrcraft advanced rear end and eMpennage oPtimisAtion enhanced by anti-iCe coaTings and devices". In work package 2 of IMPACT AAC conducts a TRL3 assessment of anti-icing coatings for aerospace applications. The expertise of AAC in coating characterisation is applied and deepened. This includes accelerated weathering, environmental simulations and surface characterisation. Link
- 2022: *LABELO*: "Laser Structured Anti-Icing Coatings for Aerospace Applications." Novel femtosecond laser structured surfaces are further chemically treated to exhibit a long lasting and strong anti-icing effect.

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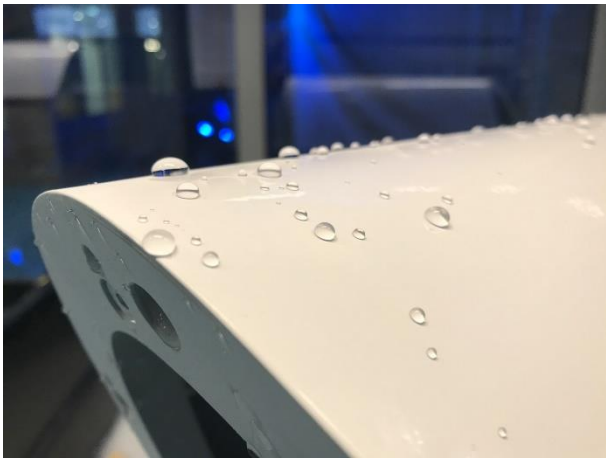
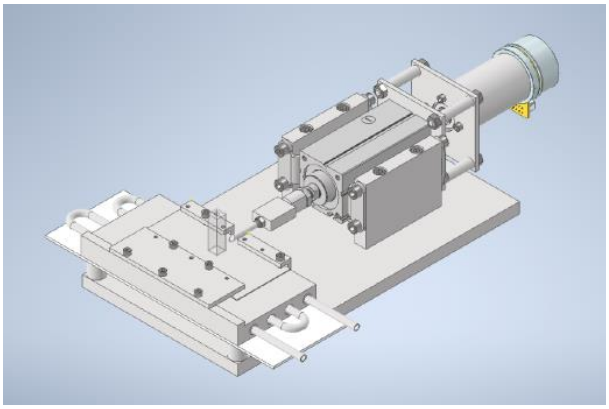
Partner Network

AAC has a strong network of partners, which grants access to:

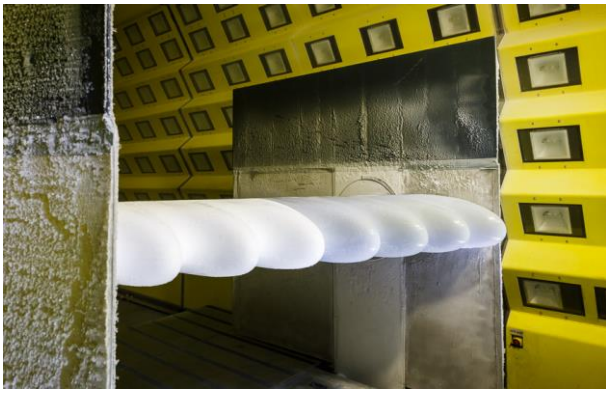
- Icing wind tunnel experiments (small scale to full scale)
- Determination of accreted ice shapes and mass
- Simulation of ice accretion
- Aviation specific rain and sand erosion tests
- Industrial production and up-scaling for anti-icing paints
- Laser patterning and plasma surface treatment
- Icing sensors



A leading edge mock up after the wind tunnel test. Coating: AAC.



Test setup for ice adhesion shear force measurement at AAC.



Icing wind tunnel test of wing mockups with anti-icing and reference coatings side by side.

Electro expulsive de-icing system and passive anti-icing coating in icing test.

Your contact at AAC:

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