LIGHTWEIGTH MATERIALS FOR MODERN AIRCRAFTS – MATERIALS SCIENCE, PROCESS AND ASSEMBLY, MATERIALS CHARACTERIZATION

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Lightweight constructions for aviation applications force important changes in the technological strategies relevant to the lightweight materials itself and in joining of different (i.e. dissimilar) materials. The goal of the lecture is to provide knowledge about lightweight materials used in aviation industry and to explain the role of advanced materials for performance and reliability of aircrafts, including assembly. The overview will include metallic lightweight materials, particularly aluminium alloys, and carbon-fibre reinforced polymers (CFRP).

Multi-material solutions for lightweight constructions that fulfill the market requirements regarding mobility, economy and ecology are highlighted. The interdisciplinary character of materials research and development for aircraft industry is demonstrated. The close interaction between design, technology and materials is shown. In particular, it will be demonstrated how design, assembly technology and new materials provide the pathway to environmentally friendly aircrafts. Analytical techniques for materials characterization are covered as well. The role of the materials scientist and engineer in aircraft industry is explained.

The focus of this lecture will be primarily on advanced aluminum alloys which are essential to meet future requirements of modern aircrafts. In this lecture, nano-engineered aluminum alloys are discussed to improve the properties of these materials for lightweight construction. Advanced aluminum alloys like Al-Mg-Sc and Al-Cu-Li are of great interest for aerospace applications due to their good mechanical property balance, excellent corrosion resistance and reduced density. The understanding of the precipitation kinetics of these alloys is essential for the properties of these alloys including their ageing behaviour. For multi-material lightweight constructions, conventional joining techniques have to be replaced by advanced adhesive bonding and hybrid joining for the production of damage tolerant designs and to extend the reliability of lightweight structures (e. g. increased maintenance intervals for aircrafts).

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