Presentation of Partner PI4 (Toulouse): CEMES-TRACES-FRAMESPA

Skills, past research, interests

Magali Brunet
CEMES-CNRS
magali.brunet@cemes.fr

Visio conference, 26/01/2021
PROCRAFT kick-off meeting with all partners
Toulouse – context in aeronautics

Past and present

✓ Research laboratories:
  CEMES-CNRS, CIRIMAT, TRACES, LAPLACE, FRAMESPA (SHS)...
✓ Universities:
  Toulouse III (Paul Sabatier), Toulouse II Jean Jaurès
✓ Engineering schools:
  ENAC, SUPAERO, ENSIACET, INSA...

✓ Industrial:
  AIRBUS, LATÉCOÈRE

✓ Museum / Associations:
  Aeroscopia, Aérothèque, Aerocerche
Team presentation

• PI4 : CEMES/ TRACES / FRAMESPA

Centre for Materials Elaboration and Structural Studies

Researchers: 61
Tech. & engineers: 37
PhD & CDD: 49
www.cemes.fr
Team presentation

- PI4 : CEMES/ TRACES / FRAMESPA

Person | Skills
---|---
Magali Brunet | Heritage materials (aluminium alloys), micro-nano characterization (SEM-EDS, TEM, FTIR, Raman, XRD, mechanical tests…)
Philippe Sciau | 
Chantal Brouca | 
Christophe Deshayes | 

Procraft - Kick off meeting
Team presentation

• PI4 : CEMES/ TRACES / FRAMESPA

Researchers: 78
Tech. & engineers: 17
PhD & CDD: 42

https://traces.univ-tlse2.fr/

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26/01/2021
Procraft - Kick off meeting
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Team presentation

- PI4 : CEMES/ TRACES / FRAMESPA

Researchers /Tech / & eng.: 95
PhD & CDD: 84
https://framespa.univ-tlse2.fr/

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Procraft - Kick off meeting
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Philippe Sciau |  
Chantal Brouca |  
Christophe Deshayes |  
Jean-Marc Olivier | History of aviation and aeronautical industries

26/01/2021

Procraft - Kick off meeting
Our approach / methodology

- Since 2013: Collection of parts on old aircraft and/or crashed aircraft

Investigation of ancient aluminium alloys

Historical context
Archives research
1. History of aluminium alloys development
   Interdisciplinary research

Audrey Cochard PhD (2013-2016)

Breguet Sahara 765 (France, 1958)

Microstructures et propriétés mécaniques des alliages de type Duralumin du Breguet 765 n°504 64-PH. Approche historique et sciences des matériaux.
Our objectives

1. History of aluminium alloys development
   Interdisciplinary research

Toufa Ouissi PhD (2017-2020)
Crashed aircraft from WWII:
France / Germany / USA / UK

Audrey Cochard PhD (2013-2016)

Breguet Sahara 765 (France, 1958)

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Breguet 765 n°504 64-PH. Approche historique et sciences des matériaux.

T. Ouissi et al., Comparison of aluminum alloys from aircraft of four nations
involved in the WWII conflict using multiscale analyses and archival study, Heritage,
2019, vol 2, Issue 4
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<th>Composition</th>
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<tr>
<td><strong>Duralumin</strong></td>
<td>- Duralumin (Fr), A-U4G (Fr),</td>
</tr>
<tr>
<td>Cu (3 to 5%),</td>
<td>- AlCuMg1 (Ge), 3115 (Ge),</td>
</tr>
<tr>
<td>Mg (&lt;0.8%)</td>
<td>- 17S (USA)</td>
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<tr>
<td>Mn (0.5-0.8%)</td>
<td>- Hiduminium DU Brand (UK)</td>
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<td>Si (0.6%)</td>
<td></td>
</tr>
<tr>
<td><strong>Super Duralumin</strong></td>
<td>- Duralumin FR (Fr), A-U4G1 (Fr),</td>
</tr>
<tr>
<td>Cu (3 to 5%)</td>
<td>- AlCuMg2 (Ge), 3125 (Ge),</td>
</tr>
<tr>
<td>Mg (0.8 to 1.5%)</td>
<td>- 24 S (USA)</td>
</tr>
<tr>
<td>Mn (0.5-1.5%)</td>
<td>- Hiduminium 72 (UK)</td>
</tr>
<tr>
<td>Si (impurity)</td>
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T. Ouissi et al., *Comparison of aluminum alloys from aircraft of four nations involved in the WWII conflict using multiscale analyses and archival study*, Heritage, 2019, vol 2, Issue 4
Our objectives

2. Fundamental Physics:
Understand the link between nanostructure and macroscopic mechanical properties. Long term aging of materials

Project StelAir (NanoX; 2016-2019)

M. Brunet et al, Comparison of long-term natural aging to artificial aging in Duralumin, Proceedings of the 17th conference on Aluminum Alloys, ICAA17, 2020
Our objectives

3. Conservation of old aircraft:
Understanding the corrosion of Al alloys

Corrosion on Breguet Sahara 765

Pitting/crevice

Exfoliation corrosion

Important factors influencing corrosion: microstructure (manufacturing) and chemical composition

M. Brunet, L. Robbiola, Ph. Sciau, M. Drieux-Daguerre, Preserving aviation heritage: the need for an approach based on material analysis, ICOM-CC Metal, Neuchâtel, Suisse, Sept. 2019, p. 425-431
**Interests:**
- Follow-up of all research axes already initiated in our team
- Conservation of aluminium alloy heritage = challenging field
- Help for associations in charge of this cultural heritage
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- Follow-up of all research axes already initiated in our team
- Conservation of aluminium alloy heritage = challenging field
- Help for associations in charge of this cultural heritage

**Our role:**
- WP1: Coordination of local partners
- WP2 (Study of wrecks)
  - Record identified WWII aircraft wrecks => corpus
  - Study of original alloys and original protective coatings
  - Documentation of corrosion types/features
- WP4-WP5 (Development and evaluation of protections)
  - Characterization of protective coatings applied by partners