# Innovative high performance Alloys and Coatings for Highly Efficient intensive energy processes

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| Project type: | Research and Innovation Action (RIA) |
| Start date of the project: | 01/10/2020 |
| Duration: | 42 months |

| **WP8: Dissemination & communication activities** | |
|---|---|
| **WP n° and title** | D8.6 Mid-term ACHIEF Workshop |
| **Responsible Author(s)** | CEA |
| **Contributors (s)** | AIMEN, VTT, PNO, TECNALIA, ENGIONIC |
| **Version** | 1 |
| **Dissemination level** | PU |

| Version | Date (MM/DD/YYYY) | Created / Amended by | Changes |
|---|---|---|---|
| **1** | 16/12/2022 | CEA | N/A |
| **2** | 17/12/2022 | PNO | Review |
| **3** | 03/01/2023 | CEA | N/A |
| **4** | 05/01/2023 | PNO | Review |
| **5** | 18/01/2023 | Partners | Review |
| **6** | 19/01/2023 | CEA/PNO | Final review |

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## EXECUTIVE SUMMARY

This deliverable is written following the mid-term ACHIEF workshop that was held on 1st of December 2022 in online mode.

# Context

## Background

The objective of the ACHIEF Mid-term workshop "Boosting High Performance Materials for Energy Intensive Industries" was to:

- Present and communicate on the objectives and expected impacts of the ACHIEF project.
- Present the ACHIEF progress achieved during the first two years of the project.
- Propose a first step in a training process before the final workshop that will present final results of ACHIEF and the validation of the research actions.
- Reach key stakeholders that could be interested in the project;
- Communicate on the ACHIEF activities and progress to the widest possible audience (academia, research and technology organisations, industry, standardisation bodies, etc.)

The workshop report (Deliverable D8.6: Mid-term ACHIEF Workshop) is related with the ACHIEF activities described in WP8, task 8.2.

## Scope

On 1st December the ACHIEF consortium gathered for an online workshop to discuss the **2-years progress of the project**. The partners presented the achievements and shared insights on the progress made in the different Work Packages from the beginning of the project with the aim of **boosting high-performance materials for energy intensive industries**.

The workshop was public, and the target audience therefore was wide and not restricted. Thanks to the communication campaign carried out on social media, and with the support of the advisory board members and the ACHIEF sister projects network, the outreach was primarily conducted throughout different industry sectors, academia, and RTOs working on similar materials.

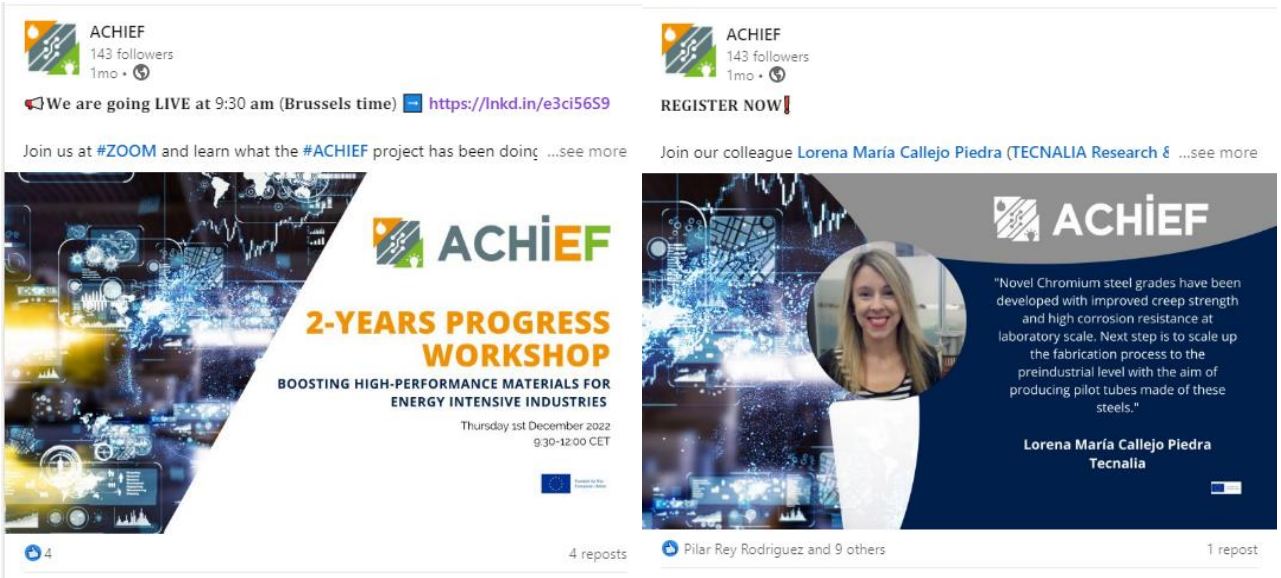


Figure 1 - LinkedIn posts to announce ACHIEF mid-term workshop

## Agenda


# ACHIEF 2-YEARS PROGRESS:

## Boosting high-performance materials for Energy Intensive Industries

Thursday 1st December
9:30-12:00 CET
Zoom platform
Link **here**

## AGENDA

| TIMING | PROGRAMME |
|---|---|
| 9:30-9:45 | **Introduction and presentation of ACHIEF**<br>Marie Cabaret, CEA |
| 9:45-10:10 | **Artificial intelligence for material selection**<br>Tom Andersson, VTT |
| 10:10-10:35 | **PDC coatings development with improved high temperature corrosion and erosion resistance**<br>Sébastien Vry, CEA |
| 10:35-11:00 | **Innovative high-temperature and creep resistance materials based on HESs models**<br>Pilar Rey Rodríguez, AIMEN |
| 11:00-11:25 | **Advanced Cr-steels with 15% improved creep resistance and high temperature corrosion resistance**<br>Lorena Callejo, TECNALIA |
| 11:25-11:50 | **Sensors developments with the ability to withstand harsh Environments**<br>Dr. Britta Koch, Engionic group |
| 11:50-12:00 | **Conclusions and wrap up**<br>Marie Cabaret, CEA |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 858374.

Figure 2 ACHIEF mid-term workshop' agenda

## Minutes of the webinar

### Introduction and presentation of the ACHIEF project

**Marie Cabaret (CEA),** coordinator of the ACHIEF project, opened the workshop. She welcomed all the participants and explained the house rules of the workshop*. Then, Ms. Cabaret presented a short introduction of the ACHIEF project covering its objectives and impacts as well as the consortium. The structure of the presentation was:

1) Project overview (*i.e.* main figures);
2) The ACHIEF consortium
3) The challenges of energy intensive industries (EII)
4) The ACHIEF concept
5) The ACHIEF workplan and value chain
6) The TRL level; and
7) The expected impacts of the project.

Note*: As the workshop was held virtually, participants could send their questions and feedback via the chat function. All questions were answered during the presentations.

### Artificial intelligence for material selection

**Tom Andersson** (VTT), presented the physics-based simulation digital tools for material generation and selection. During his presentation, Mr. Andersson explained that High Entropy Alloys (HEA), or in more general terms compositionally complex alloys (CCS), are a promising material group for many applications especially for those under harsh environment conditions.

On the one hand, the design of new CCS is demanding as they are - by definition - complex and, on the other hand, the design rules for traditional metal alloys are not applicable. In this context, there is an almost infinite amount of possible alloy compositions which yields the trial-and-error methods practically unusable. With the aim to solve these challenges, the ACHIEF project has developed and used an artificial intelligence (AI) tool based on generative adversarial network (GAN) approach. Thanks to this tool, it is possible to predict the interactions between many alloying elements in a very fast manner.

Currently the AI tool is sensitive for the initial assumptions and choices. In addition, a verification phase with physics-based tools (*e.g.* CalPhad and/or atomistic methods) is still needed. However, the design cycle is relatively fast since only a limited number of most promising candidate materials need to be computed with more time consuming methods.

The process by computing the evaluation of the candidates can be performed in high-throughput integrated computational materials engineering (ICME) means. Indeed, it is needed to first compute the solidification temperatures and to put in evidence the presence of beneficial/wanted phases with CalPhad tools.

Then, an analysis of properties and deformation mechanisms with atomistic methods is performed leading to the ICME chain all the way to the analysis of material behaviour and performance metrics with crystal plasticity methods.

### PDC coatings development with improved high temperature corrosion and erosion resistance

**Sébastien Vry (CEA)** talked about the PDC coatings development. In the framework of the ACHIEF project, the consortium is developing a protective coating using polymer derived ceramics. The developed coatings will aim to reduce the defects caused by wearing and oxidation in two use cases: melted aluminium

environment and in acidic gas media. Consequently, it would lead to an increase of durability and a reduction of replacing frequency. The solutions developed would benefit also in reducing the risks on the process safety, save costs and energy consumption.

### Innovative high-temperature and creep resistance materials based on HESs models

**Pilar Rey (AIMEN)** presented the objective of developing new High Entropy Alloys by atomisation to be printed by using laser based- additive Manufacturing processes (LPBF & LDED) to increase high-temperature performance of components used in Energy Intensive Industries (steel and aluminum industries).

Two material candidates were selected in WP2 to be compared, on the one hand, one from the literature and, on the other hand, one proposed by the Artificial Intelligence and the physical simulation digital tools. These two materials were manufactured by VTT and then processed using laser processes by CEA (LPBF) and AIMEN (LDED), the manufacturability of first material was more demanding than expected. However the processes used to produce and apply the candidates presents promising results, in particular in the case of the material selected using digital technologies. In the upcoming months, AIMEN & CEA will carry on material analysis, optimise process parameters and afterwards, the quantity produced to allow manufacturing and testing at industrial scale will be upscaled (this will be performed by SEAMTHESIS partner).

### Advanced Cr-steels with 15% improved creep resistance and high temperature corrosion resistance

**Lorena Callejo (Tecnalia)** stressed the important work done in the ACHIEF project by developing – at laboratory scale – novel chromium steel grades with improved creep strength and high corrosion resistance.

The next step is to scale up the fabrication process to the preindustrial level for the manufacture of pilot tubes made of these steels. Thus, Lorena explained that these pilot tubes are aimed at creep applications and will be validated in a pre/industrial environment.

### Sensors developments with the ability to withstand harsh Environments

**Britta Koch (Engionic Group)** explained the work done related to the sensors developments. In the process, high temperature material performance of a HESA hit candidate is to be validated within a harsh industrial use case environment. The temperature and strain as ambient parameters are of great importance and are to be characterised by embedding fiber optic sensors that are known to withstand the harsh conditions.

The initial results carried out by Engionic Fiber Optics and AIMEN could develop a sufficiently temperature-stable sensor design. According to preliminary experiments it can survive the installation procedure that includes exposure to additive manufacturing conditions for embedding (laser welding). In addition to the materials coating, a metal layer will stabilise the otherwise brittle glass fiber and ensures good thermal conductivity. Thermal fatigue testing reveals satisfying sensor performance over more than two months and across temperature intervals of almost three orders of magnitude. Britta explained that the next steps will be to embed the sensors in the HESA material and collect the measurement data at the test site.

## Perspectives

ACHIEF mid-term workshop was a great opportunity for the different stakeholders to present the promising results obtained after two years. During this first period we faced some unplanned events that are fully part of challenges that present Research and Innovation project. Next months will be a source of additional

innovative outcomes by continuing to characterise the materials and validating them at industrial scale in the different use cases.

The organisation of the workshop was successful. Zoom was the platform used to display the workshop. By using this dynamic platform the audience was allowed to interact and ask relevant questions to the speakers.

Due to the great results, discussions about future events were carried out within the ACHIEF consortium. As a result, the consortium discussed the option of organising the ACHIEF final event in the context of a European event - physical or hybrid format – with the aim of reaching a wider and relevant audience (key stakeholders). Further discussions will continue in the future.


Figure 3 - Screenshots from ACHIEF mid-term workshop

## Statistics

25 people registered to the webinar via Eventbrite (here) and 186 visited the Eventbrite page.
41 people attended the webinar (Zoom platform)
Duration of the workshop: 170 minutes
Social media promotion:

- LinkedIn: 2.039 impressions and 107 clicks
- Twitter: 555 impressions, 26 likes, 4.3% engagement rate

The ACHIEF partners and sister projects (*e.g.* CIRMET project, Bamboo EU project, CEM-WAVE) supported the promotion of the workshop.