ACHIEF project: towards high performance alloys and coatings to enhance efficiency in harsh applications

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The energy-intensive industry in Europe plays a pivotal role in the region's economy, sustainability efforts, and technological advancements. As an economic backbone, industries like aluminium, chemicals, and steel production are crucial for supply chains of virtually all productive sectors, on top of providing millions of jobs, and contribute significantly to the European GDP. Innovation at energy-intensive industries is fundamental to global competitiveness, infrastructure development, energy security, and the accomplishment of sustainability goals in Europe and around the world.

ACHIEF project aims to develop novel materials and protective coatings that can withstand extreme and fluctuating conditions typical in energy-intensive industries. Such emerging technologies (TRL3-4) are expected to be demonstrated in industrial conditions (TRL5) in aluminium, steel production and oil & gas refineries processes supported by advanced temperature and corrosion sensors and by an AI-aided material design toolbox. In this context, the ACHIEF project will enhance energy efficiency and reduce operation cost, but also improve the material performance under extreme conditions and reduce the environmental impact.

The material engineering in the scope of the project is to develop:

- High-temperature strength and creep resistance materials based on novel High-Entropy Alloys (HEAs) for improved performance of EII.
- Novel protective Polymer Derived Ceramic coatings with improved high-temperature erosion and corrosion resistance.
- High performance coatings based on HEA-nanocomposites with improved high-temperature wear and thermal fatigue resistance.
- A new high Chromium steel grade with enhanced creep resistance.

Based on the knowledge gained from the ACHIEF project, several barriers must be addressed in future projects. Firstly, transitioning from lab-scale to industrial-scale for the developed materials and coatings presents challenges in manufacturability and integration into the innovation process in the early stage. Secondly, demonstrating the effectiveness and reliability of these technologies in industrial environments is complex, requiring an agile innovation process with a focus on the industrial validation requirements of new materials. Lastly, overcoming initial market resistance and demonstrating clear economic and environmental benefits are essential for broader industry adoption. In a promising way, researched materials hold relevance across various sectors, specifically for infrastructure development including power generation, renewable energy generation, and waste processing.

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