Near Solidus Forming (NSF)
Coupling complexity and special characteristics
Mondragon University is a practical, innovative and committed university, focused on the development of people, oriented to the needs of the company and society, conceived to meet the challenges of the real world where knowledge and its application have no limits.

The university is composed by 474 people and it accepts around 5700 students yearly. 76% of the professors are active in research activity, being the 50% of the conducted research funded directly by the companies. This close collaboration has meant a good relationship with about 250 companies.

Regarding the faculty of engineering, and more precisely the Advanced Material Forming Processes research group, the research field is mainly focused on metal forming. Areas such as metal casting, bulk and sheet metal forming, hybrid material processing and joining are covered, among others.

For a deeper understanding of the capabilities of the research group, please use the following link.
Near Solidus Forming (NSF)

**The process:** The NSF process is a novel advanced manufacturing technique situated between conventional hot forging and semi-solid processes [Link].

**Main characteristics:**
- As forged mechanical properties
- Unique deformation stage
- Great grain refinement
- Capability of attaining complex shapes
- Near-net-shape process

**Main benefits:**
- Waste reduction
- Energy consumption reduction
- High-strength complex components attainable
PROPOSAL INTRODUCTION (I)

Vision: the main goal of the proposed project lies on manufacturing complex geometries with near zero waste and using high-value alloys that are conventional difficult to produce. The aim is to show proof all through to final user the capability of the novel NSF process in removing geometric or material restriction that exist with the current forming techniques.

Motivation: hot forging enables the manufacturing of high-strength components. However, the higher the complexity of the geometry or the difficulties of the material formability, the higher the material waste. Recently, the novel NSF process has shown the ability to reduce the material waste in comparison with hot forging attaining the same mechanical properties and reducing the required load by almost 10 times [Link]. This project, thus, wants to use the NSF to manufacture complex geometries using especial and high-value alloys.

Content: the project will essentially require the following steps to attain the main goal:

- Material thermomechanical and microstructural characterization.
- Feasibility trials (process parameters testing and component microstructural evaluation)
- Final component manufacturing
- Components testing and economical evaluation
PROPOSAL INTRODUCTION (II)

Expected outcome: the project wants to continue showing and discovering the great potential of the NSF process, as summarized in the following points:

• First, this work wants to successfully manufacture complex geometries using high-value materials that are currently difficult to use in the forging industry (such as stainless steels, tool steel etc). The flow of which is

By linking each of these sections then defining the optimal state to receive the component from the stage before will help fully optimize the components and prove full process chain producibility.

• Second, apart from showing the capability of using those alloys in the process, this work also aims to carry out a full economic and environmental impact assessment of producing parts in this manner compared to conventional processes, e.g. to achieve components with as forged characteristics while reducing the material waste to almost zero.
PROPOSAL INTRODUCTION (III)

**Impacts:** To reduce limitations on designs and material usage in forged components and to help bring in this new technology with its improved properties, closer to market.

**Schedule:** initially, the project is thought to begin on September 2021 and last 2-3 years.
PARTNERS

Current Consortium: the current consortium consists of Mondragon University (MU-EPS) and the Warwick Manufacturing Centre (WMG) of the University of Warwick.

Partner search: we are looking for partners of the following profile:

- End users
- Forging companies
- Steelmaking companies working with stainless steels, high recycled steels or special alloys.
- Companies or research centers with expertise on Life Cycle Assessments.

Regarding the origin, we prioritize UK and Spanish companies, but we are opened to work with any company, research center or university all over the world.
CONTACT INFO

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