

## ALPmat: A Platform for Collaborative AI-driven Advanced Materials Design

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The use of artificial intelligence (AI) in materials science is often hindered by fragmented data, limited tool interoperability, and a lack of scalable, reproducible research infrastructure. Experimental and simulation data are usually heterogeneous, poorly integrated, and hard to share securely, while AI-driven workflows need coordinated data management, provenance tracking, and access to computational resources.

To address these challenges, we have developed the Materials Acceleration Platform ALPmat, an integrated environment that combines services for data management, AI, and physics-based modelling [1]. ALPmat's capabilities are demonstrated through a case study on optimizing Advanced High-Strength Steels with bainitic microstructure, in which an Active Learning Loop (ALL) was used to improve uniform elongation and yield strength as a function of chemical composition and processing conditions.

In this presentation, we show how ALPmat supports the full research lifecycle, from FAIR-compliant data ingestion and customized data models to rapid data exploration, visualization, and execution of data-driven optimization services. By integrating literature and experimental data, modeling results, and AI tools into a single platform, ALPmat facilitates efficient exploration of complex processing-structure-property relationships. In the case study, this led to the identification of bainitic steel compositions and processing conditions with improved mechanical performance. This example shows how a unified materials research platform that provides robust data management and computational resources for AI-based methods can accelerate materials design, with a huge potential beyond the presented case study.

### References

- [1] Daniel Scheiber, Natalia Bedoya, Bernd Schuscha, Dominik Brandl, Lorenz Romaner, Jürgen Spitaler. Berg Huettenmaenn Monatsh 169, (2024) 234–240.