Ontology-Driven Digitalisation of Laboratory Research in Materials Science

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Abstract

The digital transformation of materials science and engineering (MSE) is reshaping how laboratory experiments are documented, shared, and reused. Electronic Laboratory Notebooks (ELNs) play a central role in this transition, enhancing data quality and reproducibility by structuring experimental records and integrating measurement data. However, ensuring FAIR (Findable, Accessible, Interoperable, and Reusable) data across MSE subfields remains a challenge due to diverse methodologies and domain-specific vocabularies.

Ontologies provide a semantic foundation for standardising metadata, structuring research workflows, and enabling cross-disciplinary collaboration. By embedding semantic models into ELNs and research data management systems, we enhance data provenance, support automation, and foster interoperability across experimental and computational approaches. This presentation explores strategies for FAIRification of laboratory processes, focusing on ontology (re)use, alignment with top-level ontologies, and the role of semantic technologies in improving research data management in MSE.