Intellegens

Advanced material design using deep learning

Alchemite™ optimized design process

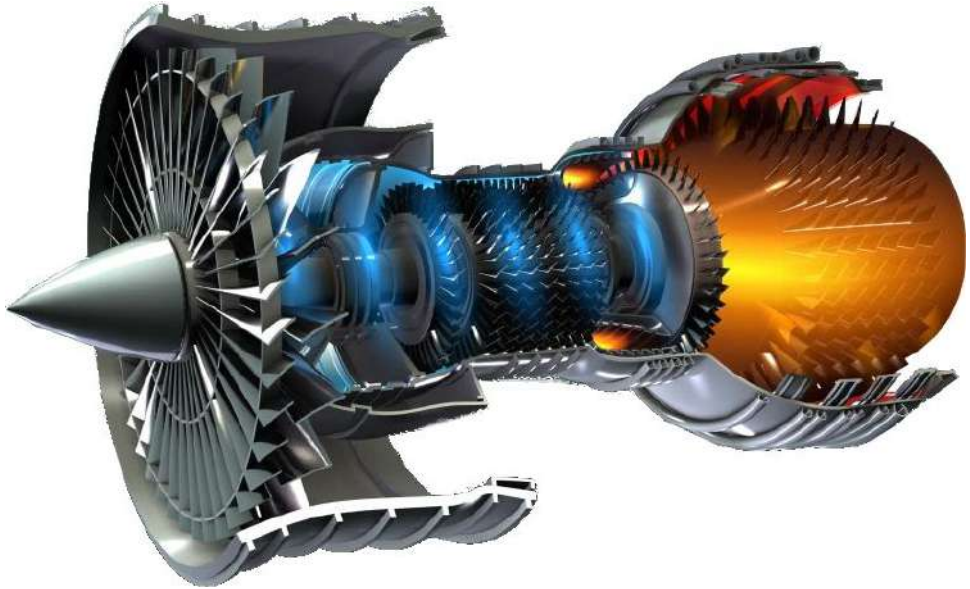
Machine learning software to aid experimental design developed at University of Cambridge

Alchemite™ predicts from available inputs

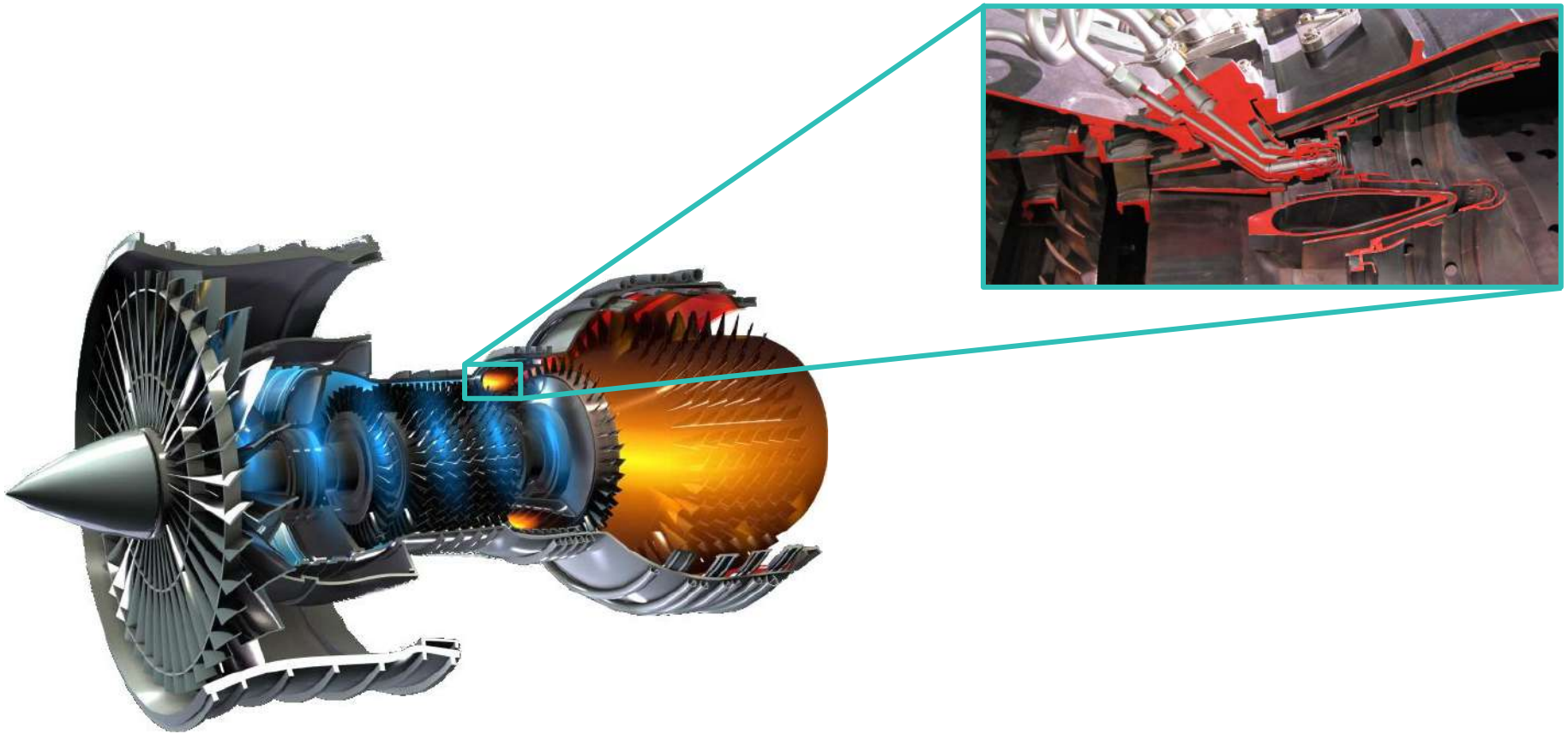
Reduce costs - 90% reduction in experiments and fewer measurements for expensive quantities

Accelerate discovery and validation to 2 years

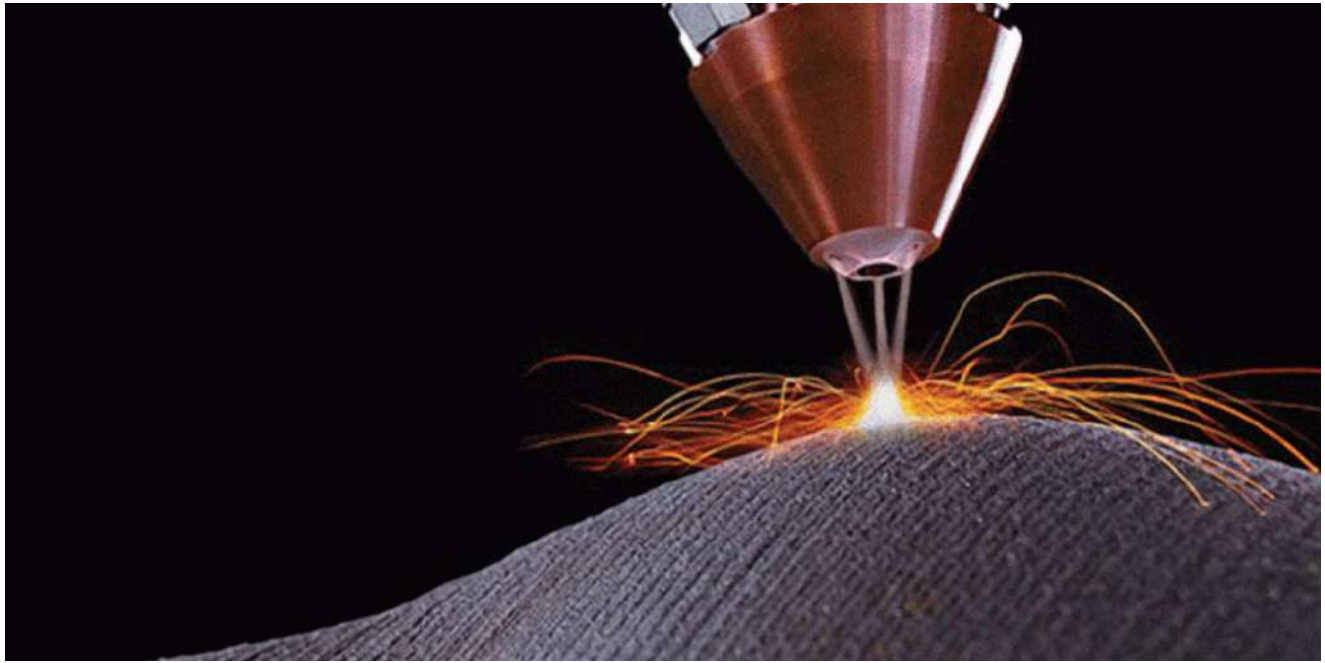
Case study: alloy for direct laser deposition



Case study: additive manufacturing



Additive manufacturing requires new alloys



Machine learning

Processability

Fatigue life

Cost

Machine learning

Processability

Fatigue life

Cost

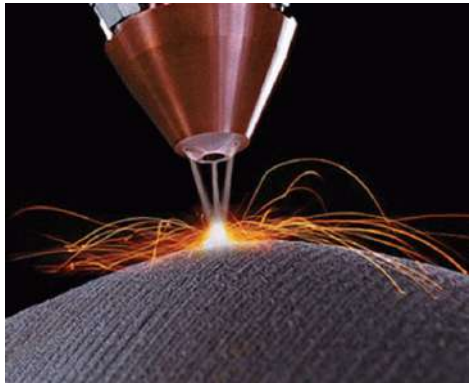
Machine learning

Processability

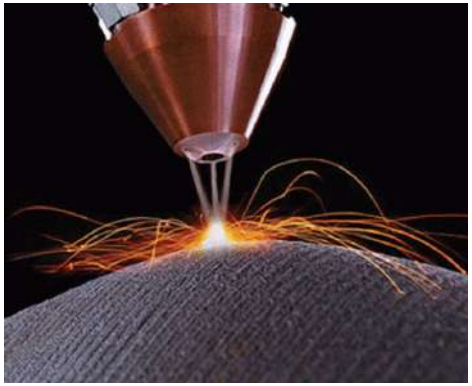
Fatigue life

Cost

Case study: alloy for direct laser deposition



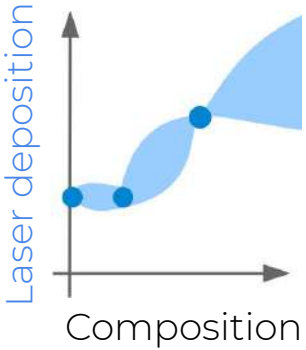
Direct laser deposition is similar to welding



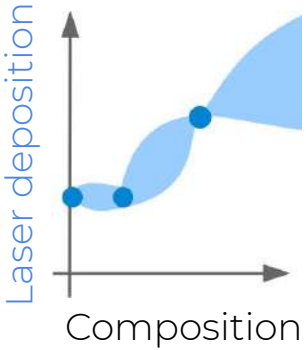
Direct laser deposition

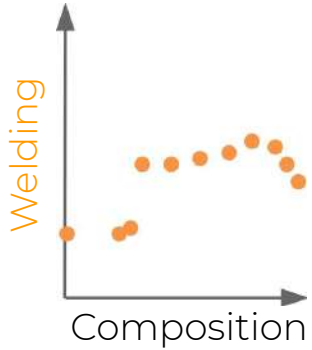
Welding

Lack of data for laser deposition

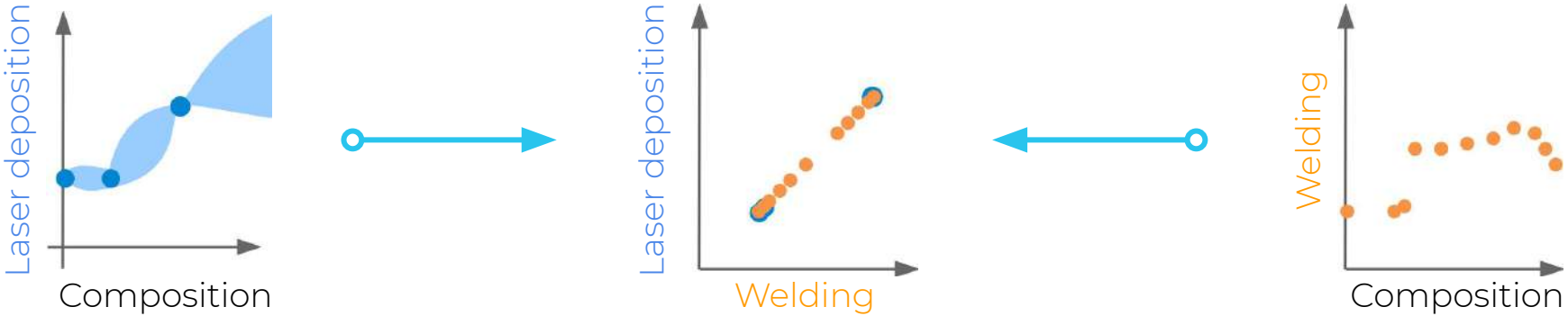


Large amount of welding data

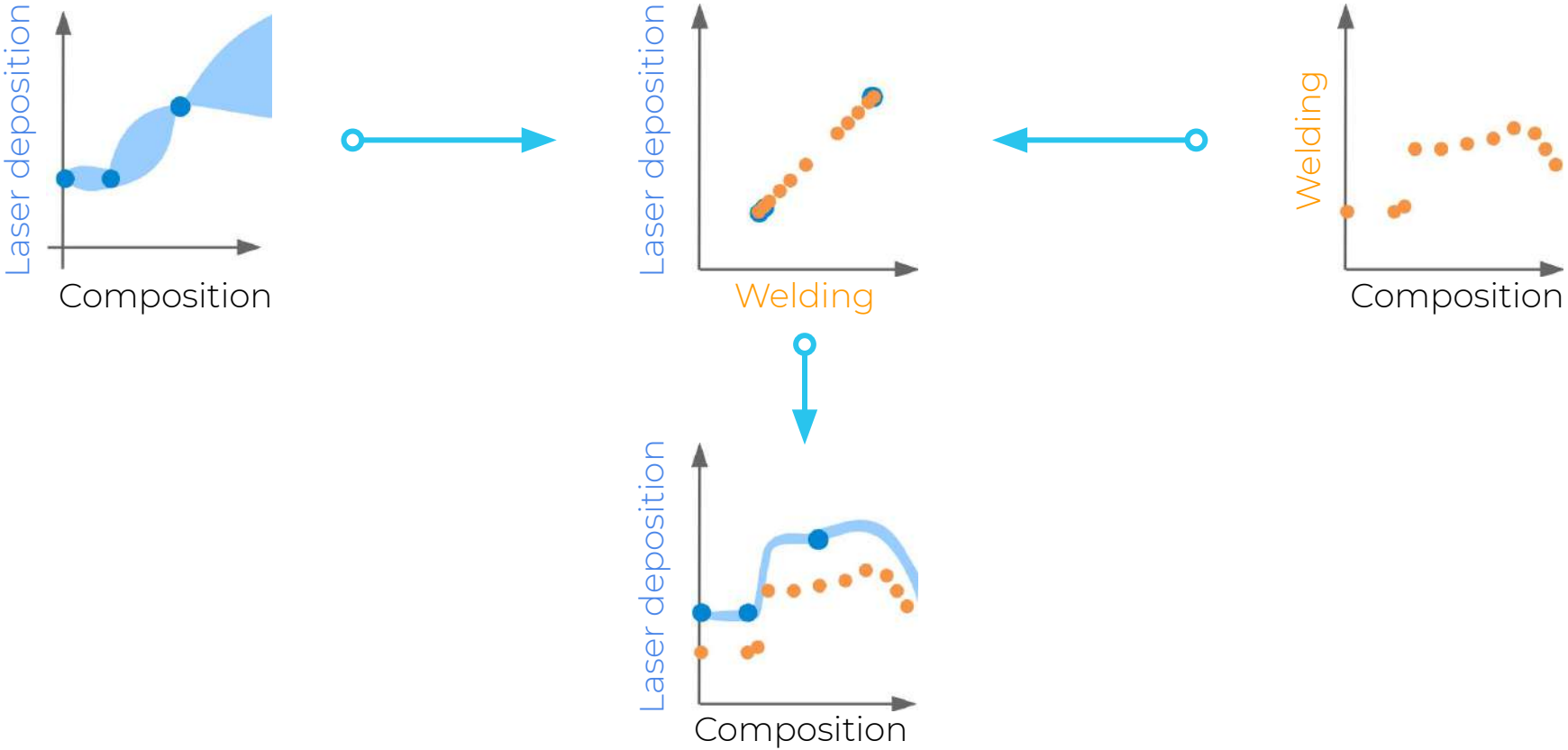




Simple welding-deposition relationship



Welding data guides extrapolation



Targets for direct laser deposition alloy

Elemental cost	< 25 $\$kg^{-1}$
Density	< 8500 kgm^{-3}
γ' content	< 25 wt%
Oxidation resistance	< 0.3 $mgcm^{-2}$
Processability	< 0.15% defects
Phase stability	> 99.0 wt%
γ' solvus	> 1000 °C
Thermal resistance	> 0.04 $K\Omega^{-1}m^{-3}$
Yield stress at 900 °C	> 200 MPa
Tensile strength at 900 °C	> 300 MPa
Tensile elongation at 700 °C	> 8%
1000hr stress rupture at 800 °C	> 100 MPa
Fatigue life at 500 MPa, 700 °C	> 10^5 cycles

Composition of alloy for direct laser deposition

Cr 19%

Co 4%

Mo 4.9%

W 1.2%

Zr 0.05%

Nb 3%

Al 2.9%

C 0.04%

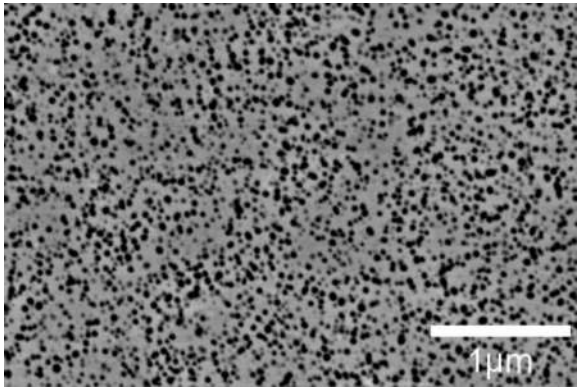
B 0.01%

Ni balance

Exposure 0.8

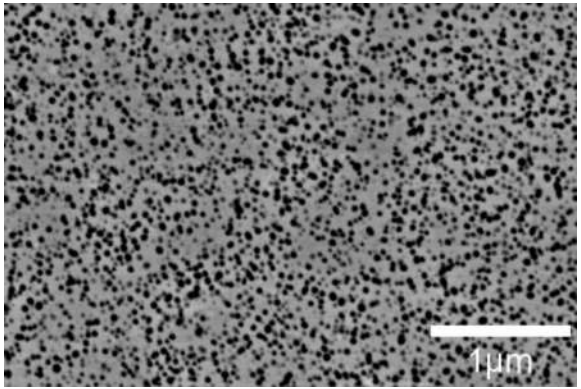
T_{HT} 1230°C

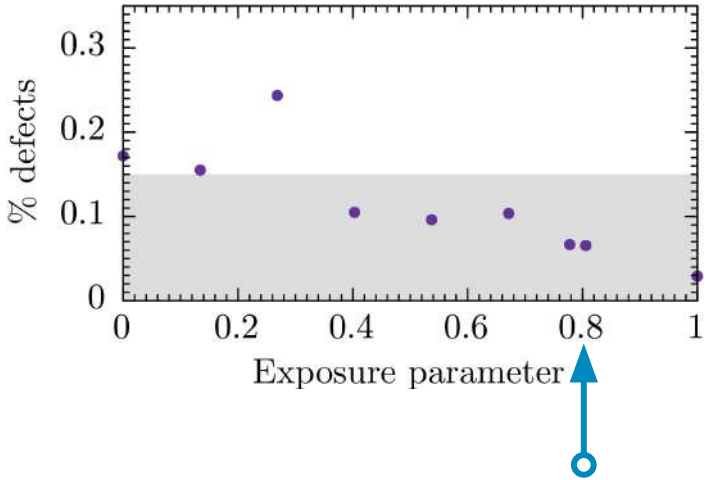
Experimental validation: microstructure



Materials & Design 168, 107644 (2019)

Experimental validation: defects

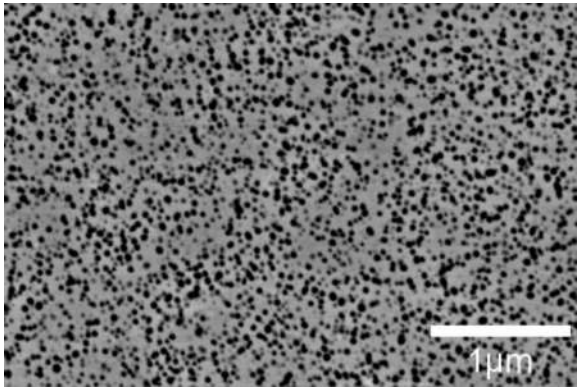


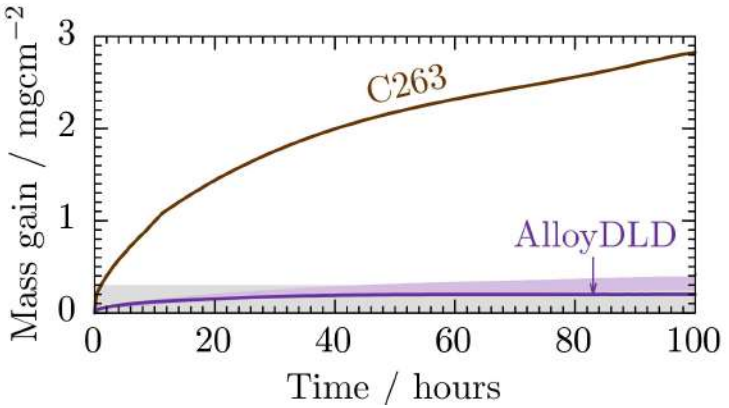


Design parameter

Materials & Design 168, 107644 (2019)

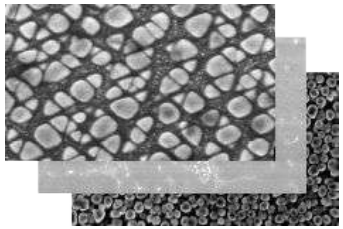
Experimental validation: oxidation resistance





Materials & Design 168, 107644 (2019)

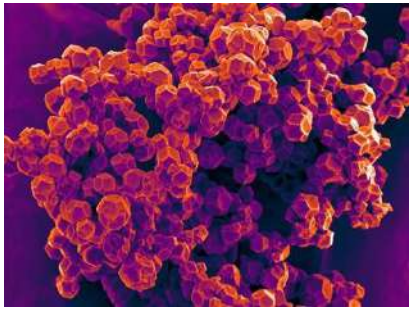
Further materials and drug design



Nickel & moly alloys

Batteries

Steels for welding



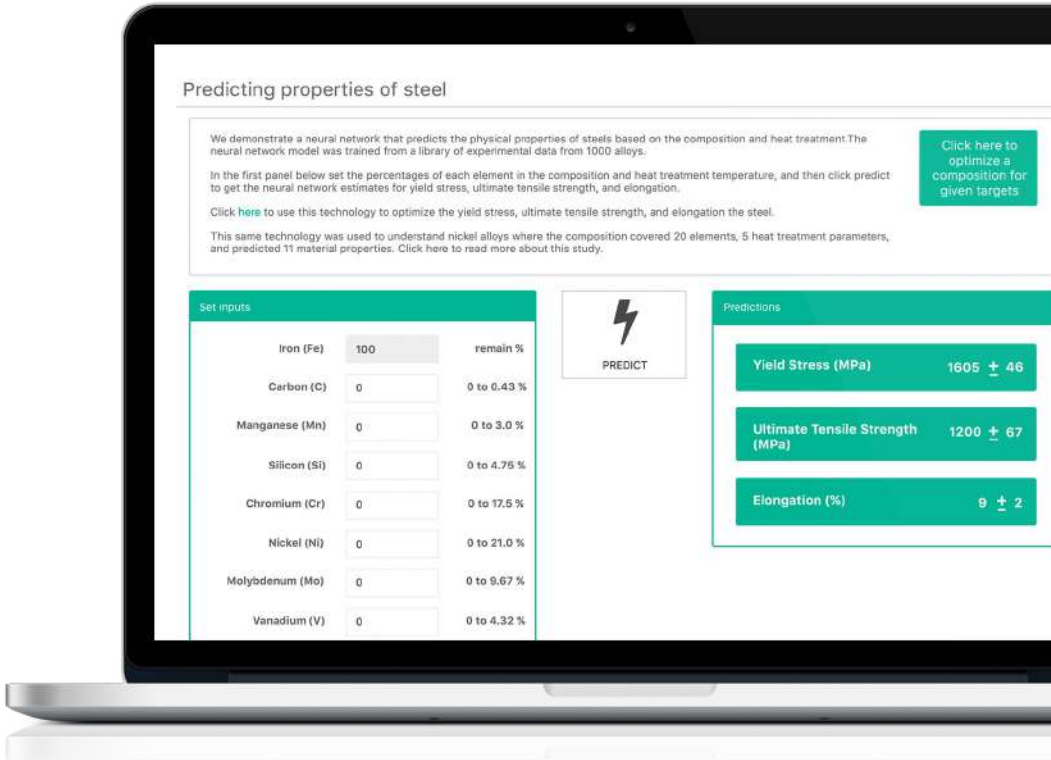
Metal-organic framework

Concrete

Drug design

Future opportunities: Integrated software

1. Load data
2. Training
3. Predict & design



Uses of Alchemite™

Validate data

Identify outliers and impute missing data

Guide experiments

Recommend the next experiment to improve understanding

Optimise formulations

Design material that satisfies targets and understand the effect of altering each ingredient

Deployment of Alchemite™

Consulting project
One-off project to design a new material

Alchemite™ engine API
Deploy AI engine via an API into current software used by organisation

Alchemite™ engine & analytics platform
Deploy for use by engineers & scientists

Bespoke tool development
Front-end development of bespoke tools for the Alchemite™ engine

Summary of future opportunities of Alchemite™

Alchemite™, a full stack machine learning solution to merge sparse data

Designed and experimentally verified material for thermometry, and other alloys and drugs

Contact	gareth@intellegens.ai
Website	https://intellegens.ai
Demo	https://app.intellegens.ai/steel_optimise
Papers	https://www.intellegens.ai/paper.html