Tailored precipitation (B2, $L2_1$) strengthened, compositionally complex FeAlCr (Mn, Co, Ni, Ti) alloys for high temperature applications

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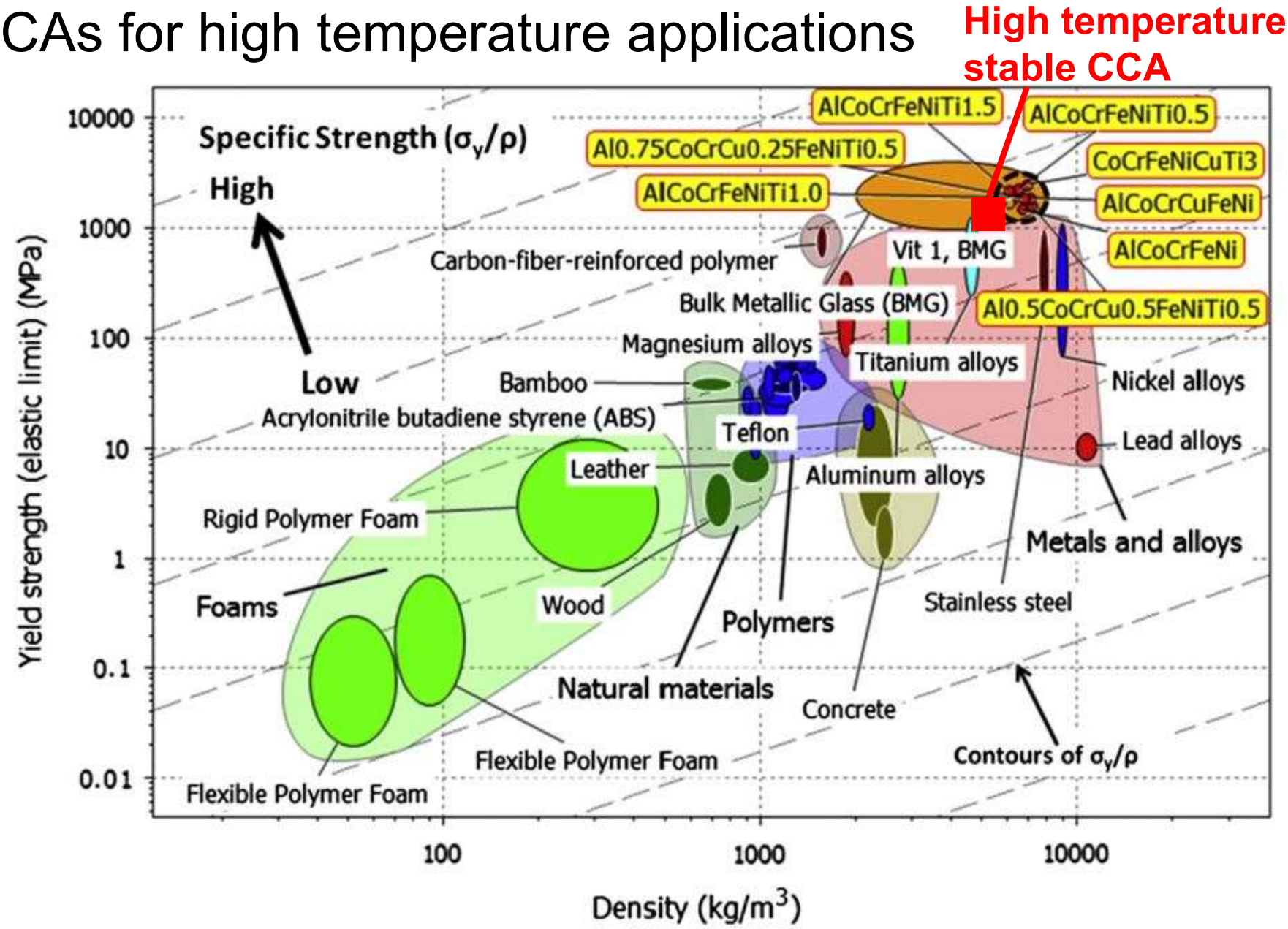
Tailor the phase decomposition in HEAs to establish CCAs for high temperature applications

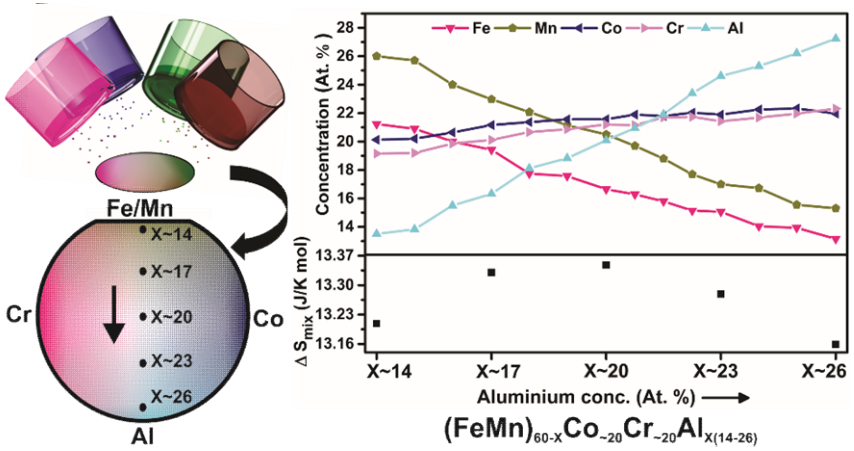


Y. Zhang, T.T. Zuo, Z. Tang et al. PMS, 61 (2014) 1-93.

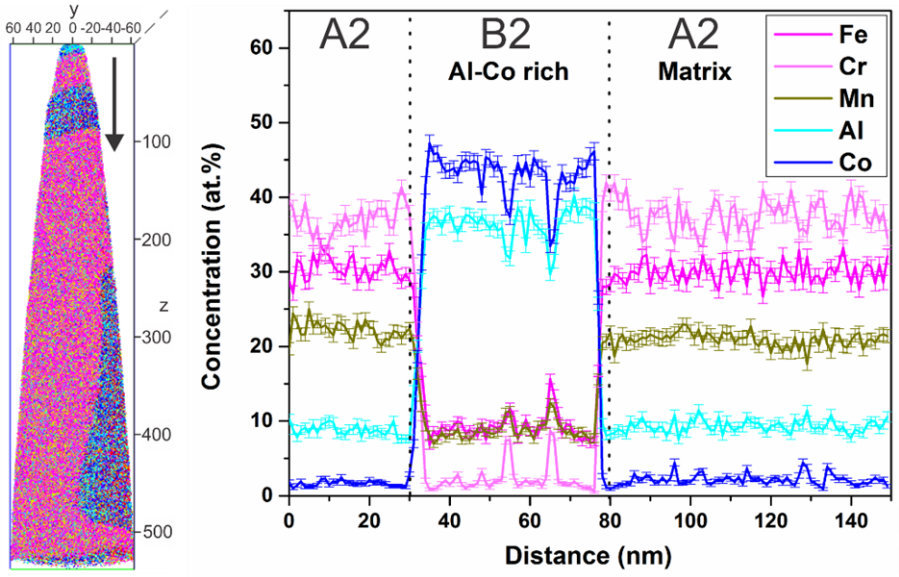
Preliminary results

HEA branch

High-throughput compositional screening

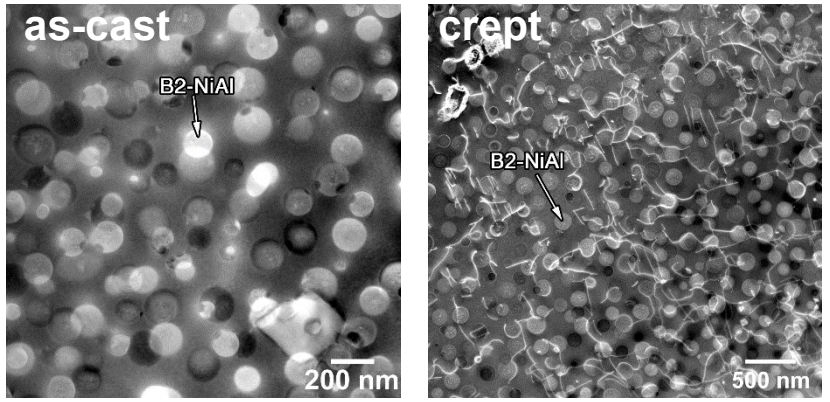


Stabilization of B2-CoAl precipitates

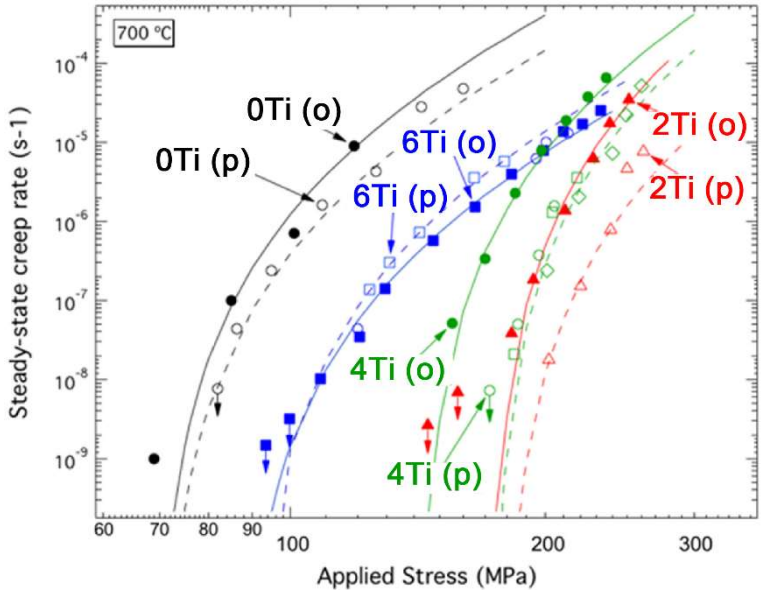


Classical alloy branch

B2-strengthened ferritic alloy (0Ti)



Control of creep properties by B2- and/or $L2_1$-precipitation

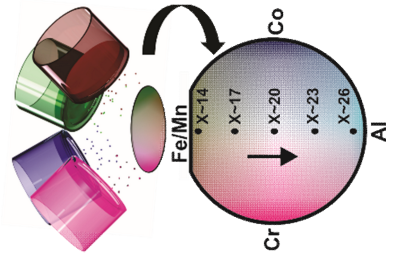


[1] N.Q. Vo, **C.H. Liebscher** et al. Acta Mater. 71 (2014)
[2] A. Marshal, **K.G. Pradeep** et al. JALCOM. 691 (2017)
[3] M.J.S. Rawlings, **C.H. Liebscher** et al. Acta Mater. 128 (2017)

Objectives and work programme

Starting alloy systems:
Fe-Al-Cr-
- Mn-Co
- Ni-Ti

High throughput screening (WP1)



Identify promising alloy candidates

Microstructural characterization (WP4)

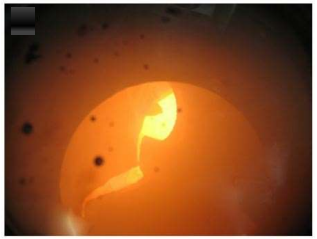
3D-APT

(S)TEM

Re-optimization loop

Objectives
- BCC-CCAs with tailored **B2/$L2_1$-precipitates**
- Low-cost, low-density alloys **6-7 g/cm³**
- Creep resistance up to **900ºC**
- Maximized solid solution strengthening & precipitation hardening

Bulk synthesis (WP2)



Microstructure based alloy optimization (SEM, XRD, TEM, APT)

Microstructure-property relationship

Bulk mechanical testing (WP3)
- **compression, tension, creep**

Property evaluation of optimzed alloys

Contributions to the SPP and collaborations

Contributions to the SPP:

- Development of CCAs for high temperature applications
- Tailoring complex composition and phase space to optimize microstructure
- Establishing future low cost, low density alloys with good HT mechanical properties
- Microstructural optimization based on scale bridging characterization

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Collaborations within the SPP:

Collaborator	provides	receives
Prof. Uwe Glatzel	Directional solidification & single crystal growth	(S)TEM characterization
Dr. Michael Feuerbacher	Synthesis poly- & single crystals	HT mechanical testing & APT
Dr. Christian Haase	Production through additive manufacturing	(S)TEM characterization of deformed samples
Dr. Sergiy Divinski	Tracer diffusion measurements	APT characterization of interfaces
Dr. Mathias Galetz	High temperature oxidation tests	Hot tension test & STEM characterization