Complex Materials in Real Environments From electronic understanding to bulk nanostructuring

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Max-Planck Institut für Eisenforschung GmbH, Düsseldorf



Foundation: 1917 as Kaiser-Wilhelm-Institut für Eisenforschung

Since 1971: Basic corporate budget financed by Max-Planck-Society (50%) and VDEh (50%)

Total budget 2012: (41% MPG, 38% VDEh, 21% third party funds)

Personnel: 250

100 years public-private partnership

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Shareholders, Structure, History, Public-Private Partnership

Max-Planck Institut für Eisenforschung GmbH, Düsseldorf ...1998: Neumann – CEO, applications, transition 1999: Stratmann, Raabe – directors board, basic science, construction 2004: Neugebauer – ab-initio, broadening, construction 2007: Pyzalla – large infrastructures (left 2008 to HGF) 2012: Dehm – in-situ, construction (Dept. Raabe renamed)

<u>Community</u>: MPG Vice-president; German Science Council; Chairman Governors Board RWTH; Fachkollegiat DFG, ESF

<u>Grants</u>: Double ERC Advanced Grant, NanoMatFuture, ECCO2, Leibniz Award, AvH, 2 SFB

<u>Education</u>: >50 PhDs (10 y), 4 Habilitations, 8 Professorships, Azubi Award, best Azubi education (IHK)

<u>Industry Outreach</u>: > 1000 personell (20 y), > 500 projects with industry (10 y): hydrogen, alloy design (mobility, energy), kinetics, thermodynamics, simulation, microstructure, damage, corrosion, coatings, magnetic materials



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Recent Devlopment, Construction, Scientific Direction, Output

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Max-Planck Institut für Eisenforschung GmbH, Düsseldorf

Stratmann

Neugebauer

Raabe

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Dehm

MPIE: personnel



Cameroon, 2

Brazil, 1

Bulgaria, 1









Scientific mission: complex materials in real environments









MPIE structure and departments





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MPIE research focus: areas of high expertise



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MPIE research focus: areas of high expertise





Answering societies' grand challenges with complex alloys

70% of all industrial innovations are associated with progress in materials science and engineering

> **Complex Materials** occupy key roles (energy, transportation, health, safety, infrastructure)

Materials-related industries account for 46% of all EU manufacturing value and 11% of the EU's total domestic product

3.5 billion € per day in the EU World Trade Organisation



Our mission: Understanding and designing complex materials and mechanisms for real environments from first principles

Max-Planck-Institut für Eisenforschung, Düsseldorf, Germany Link to Society: Complex Materials enable Innovative Manufacturing 11



SURMAT: Max-Planck Graduate School

International Max Planck Research School

- Structured PhD programme (since 2004)
- MPIs in Düsseldorf and Mülheim, Ruhr-Universität Bochum, ICAMS
- Interdisciplinary: catalysis, corrosion, interfaces, thin films, alloy design
- Evaluation spring 2014: application for 6 years extension

Since 2004:

- 84 students 27 countries (1180 applicants)
- 42 PhD 7 with distinction
- 193 peer reviewed papers







Rapid alloy prototyping: combinatorial design of complex alloys



Combinatorial strip casting







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RAP: Steel-plant-in-a-box



6 months \rightarrow 5 days

Plasma-powder synthesis



Rapid screening of complex bulk alloys including tensile testing 15

