



Complex Solid State Reactions for Energy Efficient Hydrogen Storage (MRTN-CT-2006-035366) 2006 - 2010

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(Nov., 1st: Helmholtz Zentrum Geesthacht, HZG)

- Marie Curie Research Training Network
<http://www.cosy-net.eu>
- Runtime **11/2006 – 10/2010**
- Total funding **2.47 Mio.€**
- **13 Partners** from Universities and Independent Research Institutions
 - Training of young scientists
 - **9 (+2) ESR / 4 (+1) ER** positions
- **6 Companies** in Industrial Advisory Board

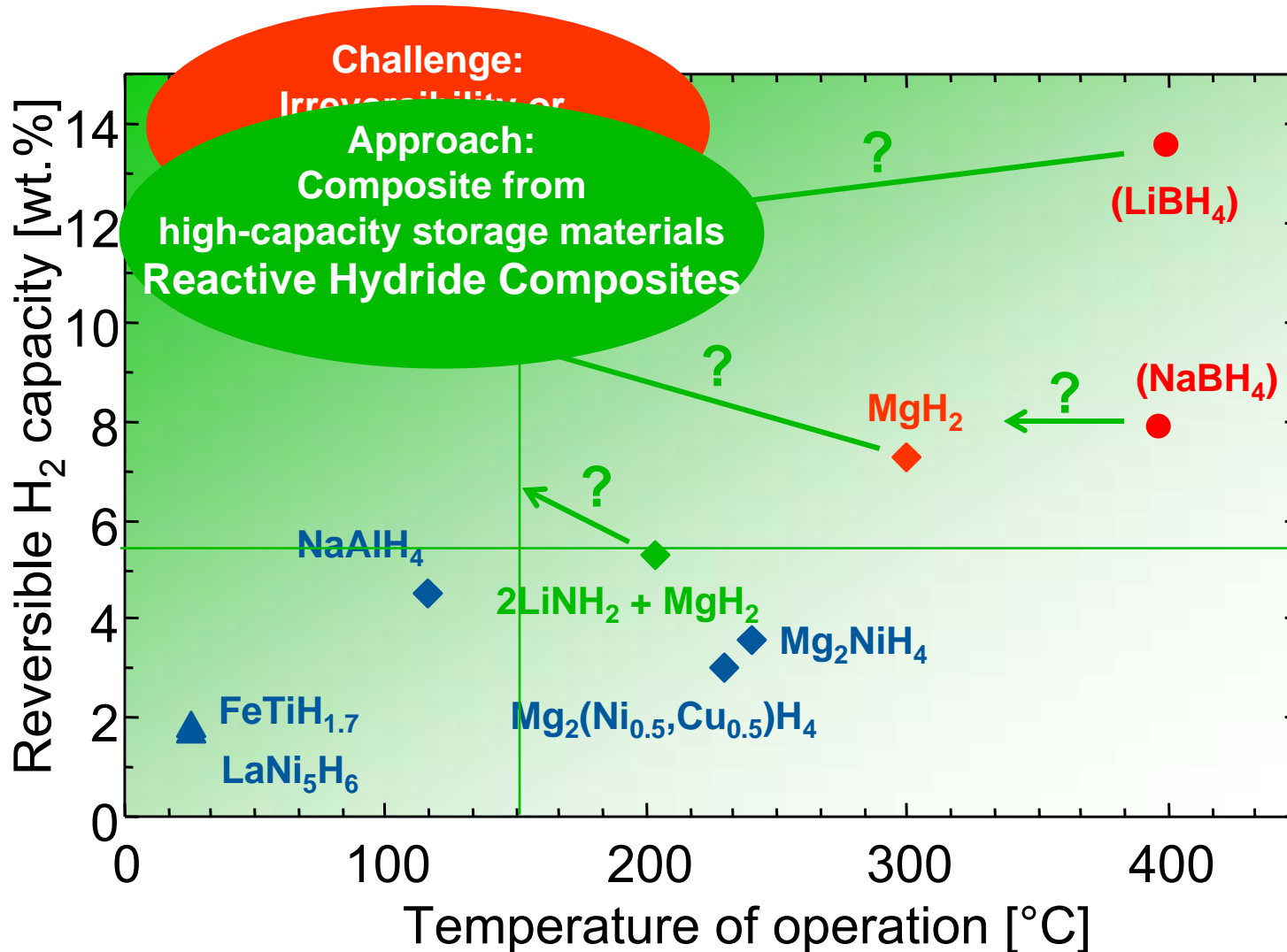


Hydrogen Storage

- **Enabling Technology** in the Hydrogen Economy

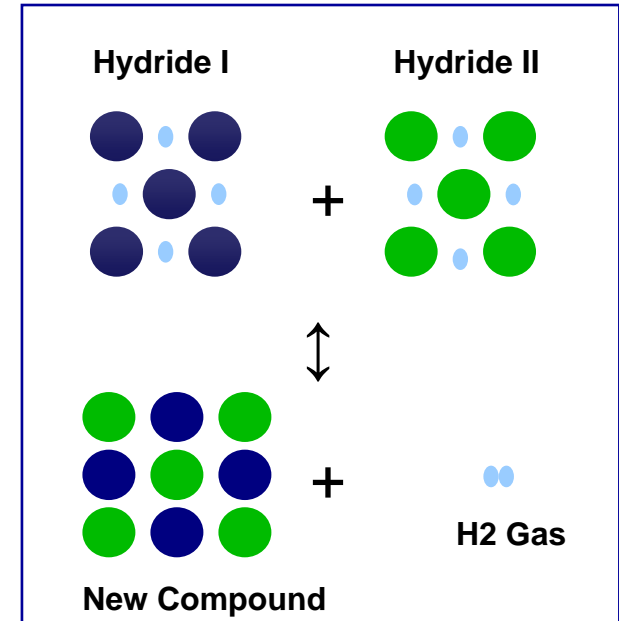
Bottle necks

- **System capacity** (weight & volume)
 - Materials ≥ 6 wt.% H₂, ≥ 40 kg H₂ / m³
- **Heat flows** during tank fuelling and hydrogen release
 - Energy efficient heat management tank \Leftrightarrow fuel cell / ICE
- **Safety** issues
 - Flammability, hazardousness
- Materials **reliability / degradation**
- Tank system **conformal to car construction**



Reaction Principle:

- **Exothermal** reaction between compounds during **endothermal** dehydrogenation
- ✓ **High capacity**
- ✓ **Reduced reaction enthalpy**
 - ⇒ **Less heat** transfer
 - ⇒ **Low equilibrium temperature**

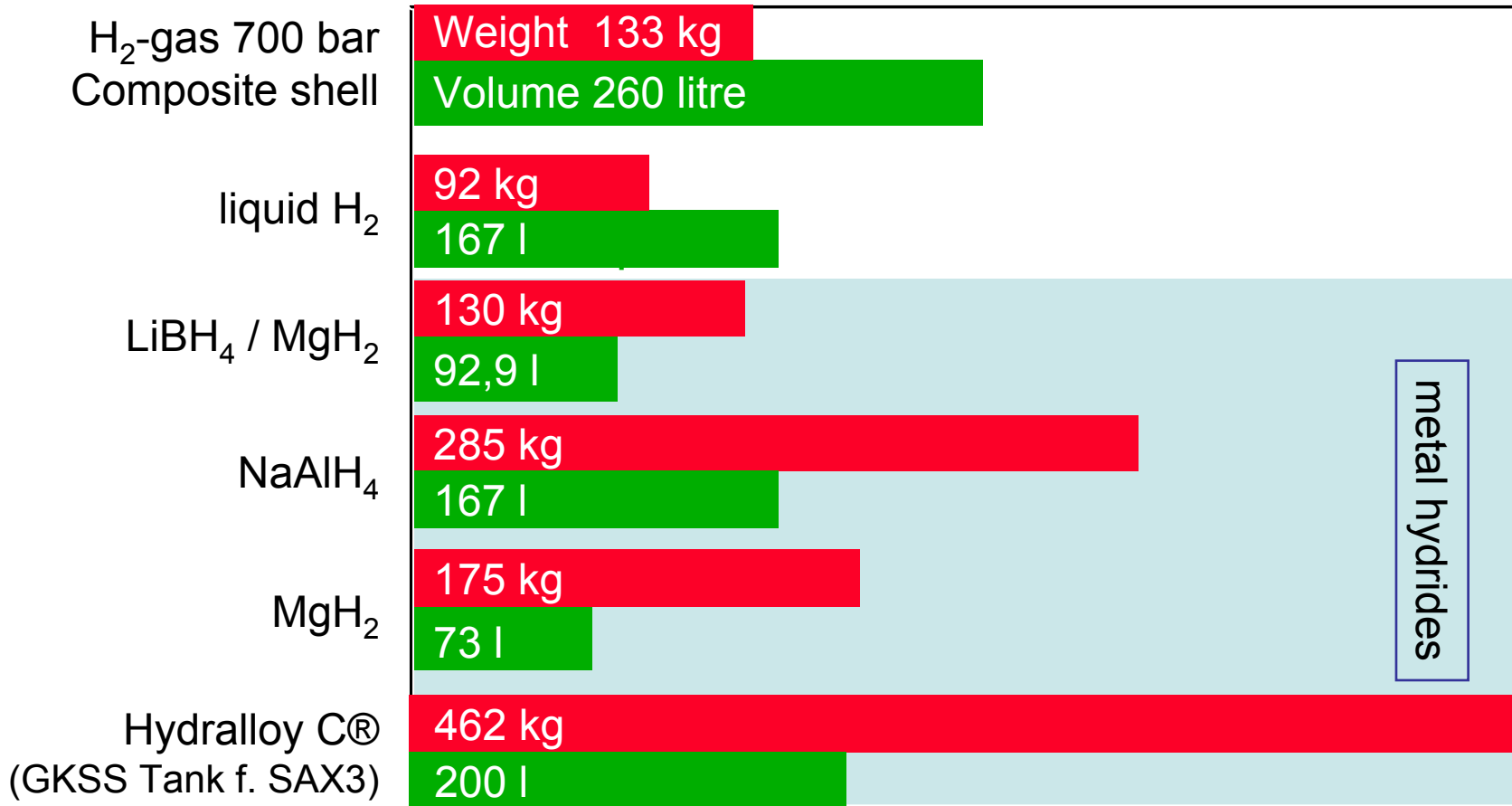


Novel Hydrogen Storage Materials

- **2 NaBH₄ + MgH₂**, ~ 9.5 wt.%, $\Delta H = - 63.5 \text{ kJ/mol H}_2$, $T_{\text{eq}} > 350^\circ\text{C}$ *
- **Ca(BH₄)₂ + MgH₂**, ~ 8.3 wt.%, $\Delta H \sim - 30 \text{ kJ/mol H}_2$, $T_{\text{eq}} \sim 80^\circ\text{C}$ *
- **2 LiBH₄ + MgH₂**, ~ **11.5 wt.%**, $\Delta H = - 46 \text{ kJ/mol H}_2$, $T_{\text{eq}} \sim 160^\circ\text{C}$ *
- **2 LiNH₂ + MgH₂**, ~ 5.6 wt.%, $\Delta H = - 30 \text{ kJ/mol H}_2$, $T_{\text{eq}} \sim 80^\circ\text{C}$

* patents pending 2004 GKSS / 2004 HRL Laboratories

Tank weight and volume for 500 km range (6 kg H₂ = 200 kWh)



(mid-class vehicle: 9 l gasoline or 1.2 kg H₂ for 100 km)

- **Fundamental understanding** of reaction mechanisms
- Determination of **rate limiting steps**
- Effect of **additives / preparation techniques** on reaction kinetics
- Optimisation of **reaction kinetics**:
 - Reversibility
 - Faster kinetics
 - Lowered sorption temperatures
- **ab initio Calculations** of stable and hypothetical structures.
- Cost effective and reliable **materials production**

- 1 + 8 Project meetings ⇒ **young researchers reports**
- 8 Network wide **training events** ⇒ <http://www.cosy-net.eu/workshops.html>
- 2 days **Complementary Skills workshop** „Curriculum Vitae / job interviews“
- **3 Young researchers workshops**, organised by fellows alone
- **3 ESR secondments** of one year duration
- **45 visits** (after 3 years) for materials synthesis, measurements and discussion of results at network partners and European research facilities (ESRF, DESY, MAX-Lab, etc.)
- **Dissemination activities** of fellows (after 3 years)
 - **28 Publications** with COSY fellows as main or co-authors
 - **56 Talks** on national and international conferences
 - **34 Posters** on national and international conferences
 - **1 patent**
- All „regular“ ESR's work on their **PhD theses**, partially already handed in
- **First PhD's** expected for end of **2010**

Andreas Borgschulte, Empa, for succesful proposal
Rüdiger Bormann, Bayreuth University, for 3 years of COSY coordination
 &
All COSY fellows for their intense & fruitful work

