

Impedance of alkali metal amidoboranes – lightweight hydrogen stores



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amidoboranes, MNH_2BH_3

- ammonia borane derivatives
- light metal hydrogen stores



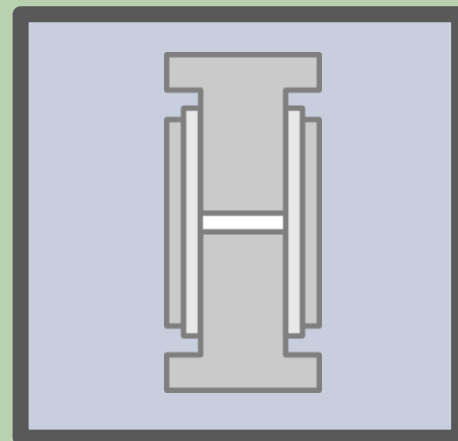
ionic conductivity of amidoboranes

- super ionic conductors
- characteristic variation of conductivity



impedance cell for reactive powders

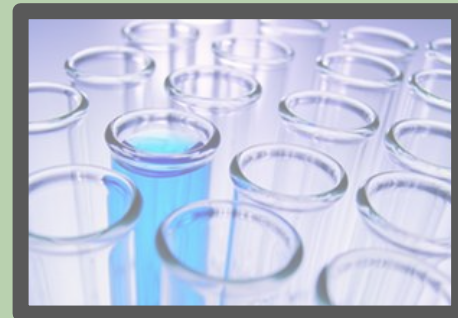
- impedance JAWS





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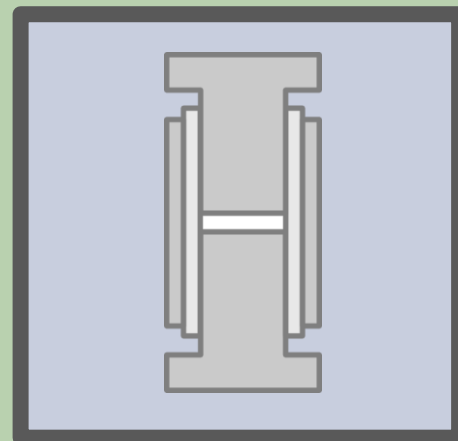
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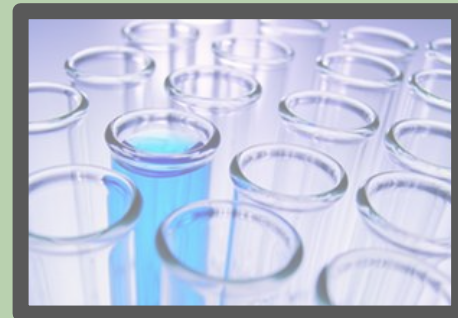
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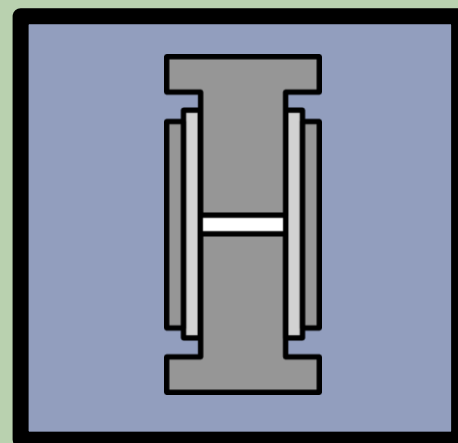
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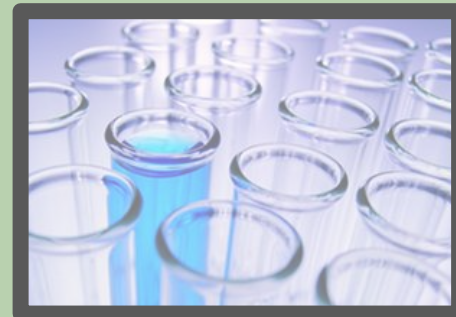
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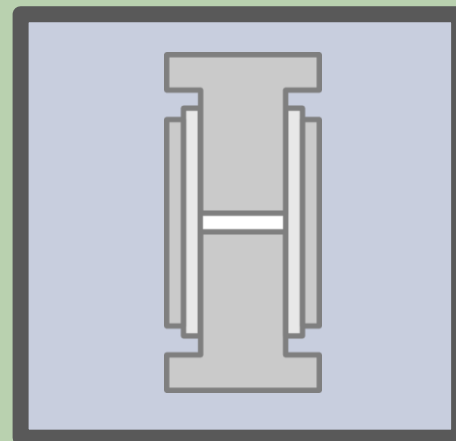
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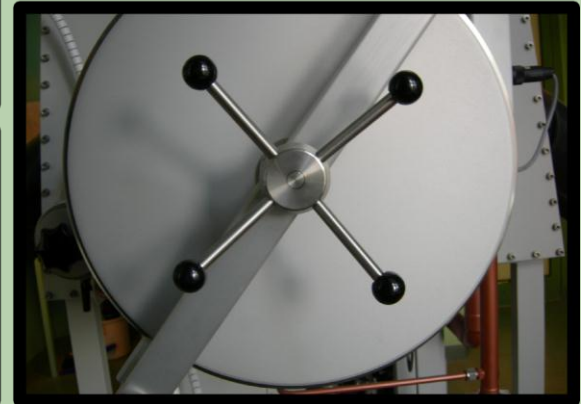
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introduction

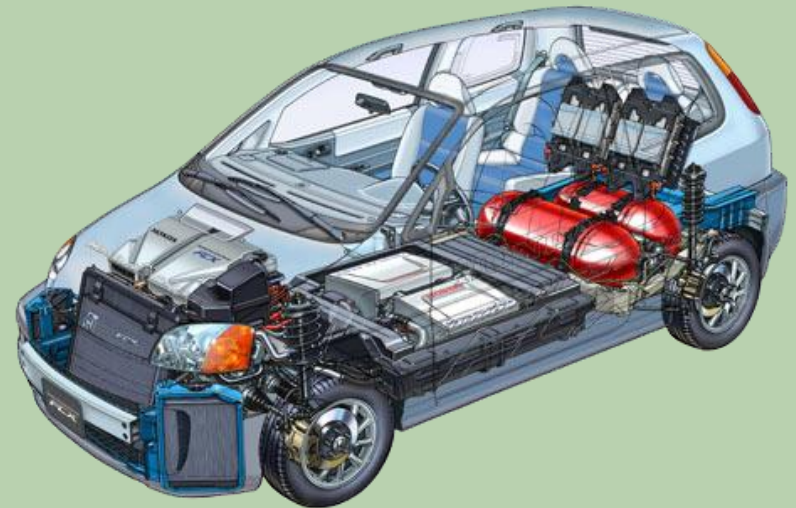


hydrogen economy

- idea of switching from fossil fuels to hydrogen
- hydrogen as energy carrier
- issues: production, **storage**, combustion

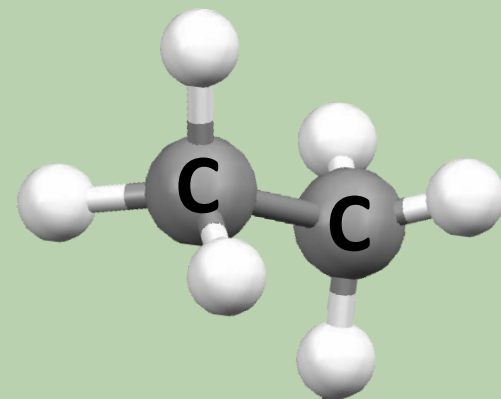
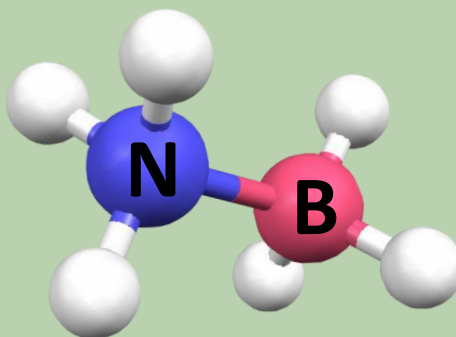
hydrogen storage – unsolved problem, DOE Targets

- capacity: 7.5%
- desorption: 60–90°C
- purity: 99.97%





- ammonia borane (NH_3BH_3) – structural analogue of ethane
- very high hydrogen content: **19,6%**



properties:

- appearance
- **melting**
- boiling
- **decomposition**
- hydrogen bonds

white **solid**

112°C (decomp.)

no

72°C

yes

colourless **gas**

-183°C

-88.6°C

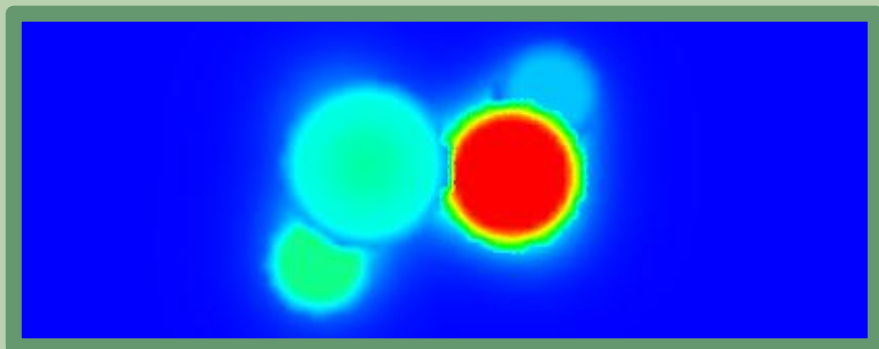
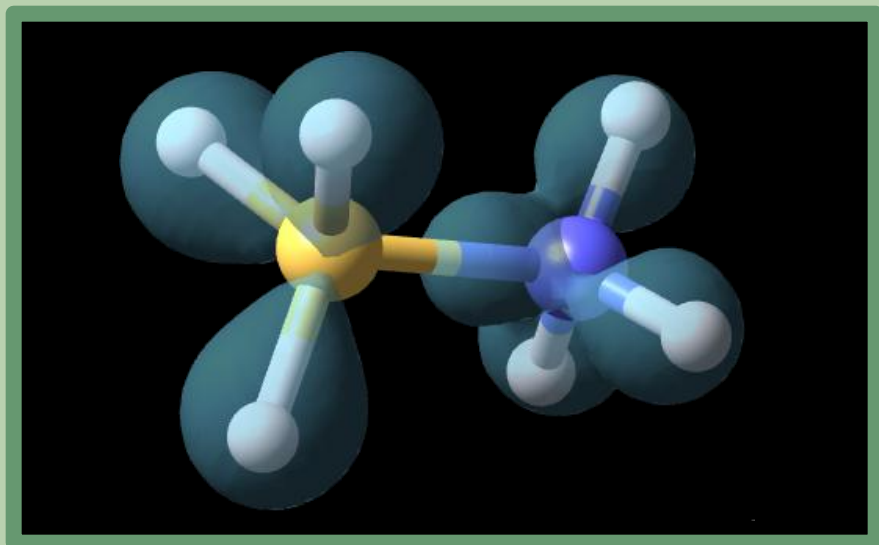
570°C

no

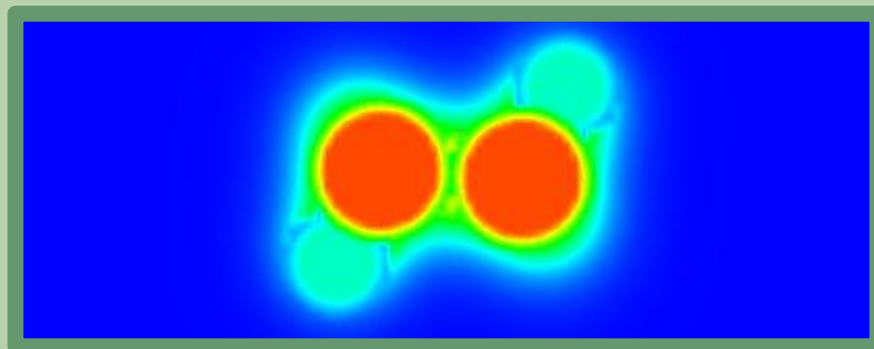
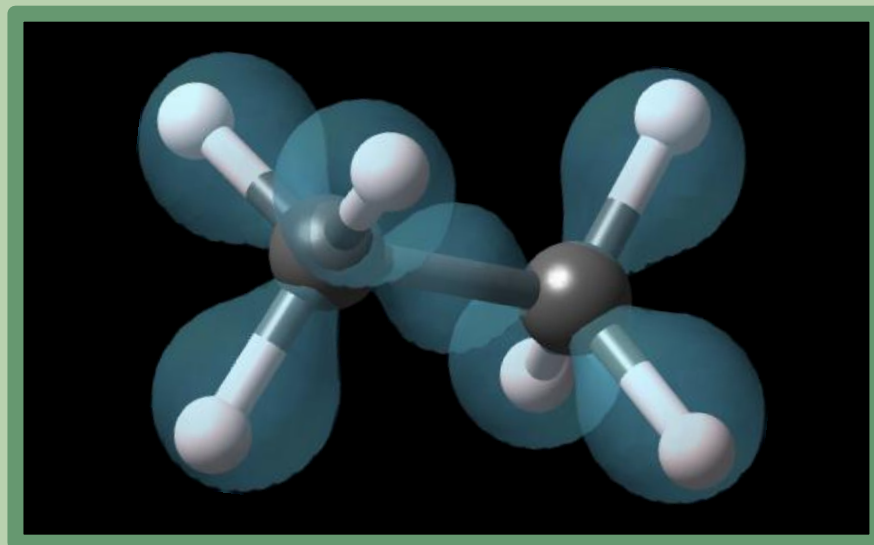


comparison of electron density distribution

ammonia borane



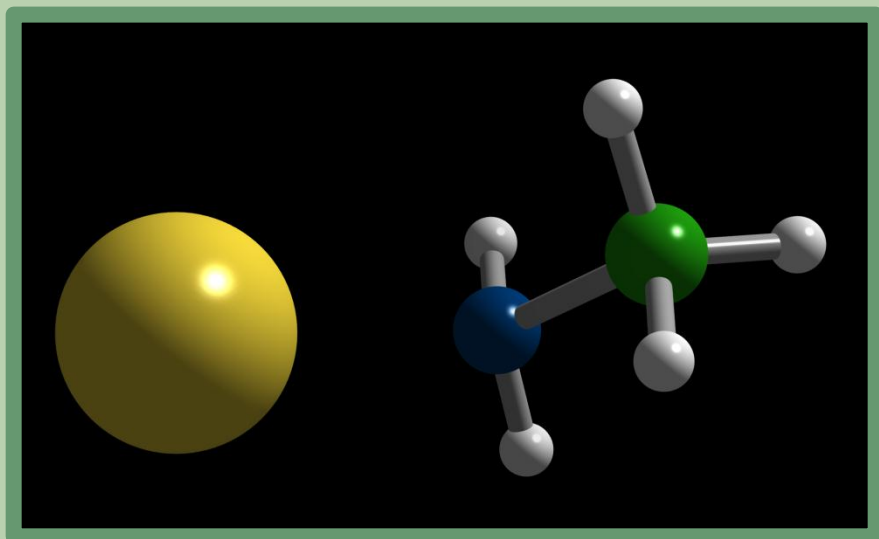
ethane



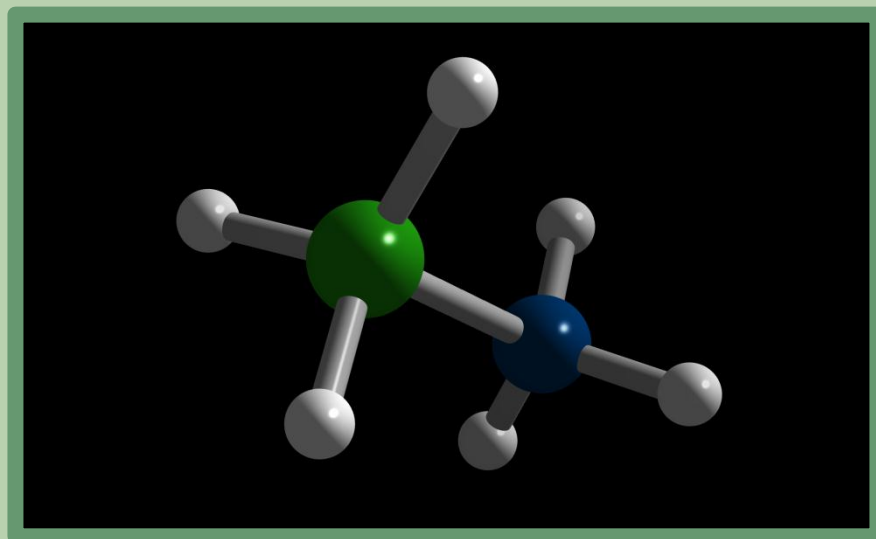
ammonia borane **derivatives**:

- target: to decrease temperature of hydrogen desorption
to minimise hydrogen impurities
- exchange of a proton into selected metal cations

sodium amidoborane

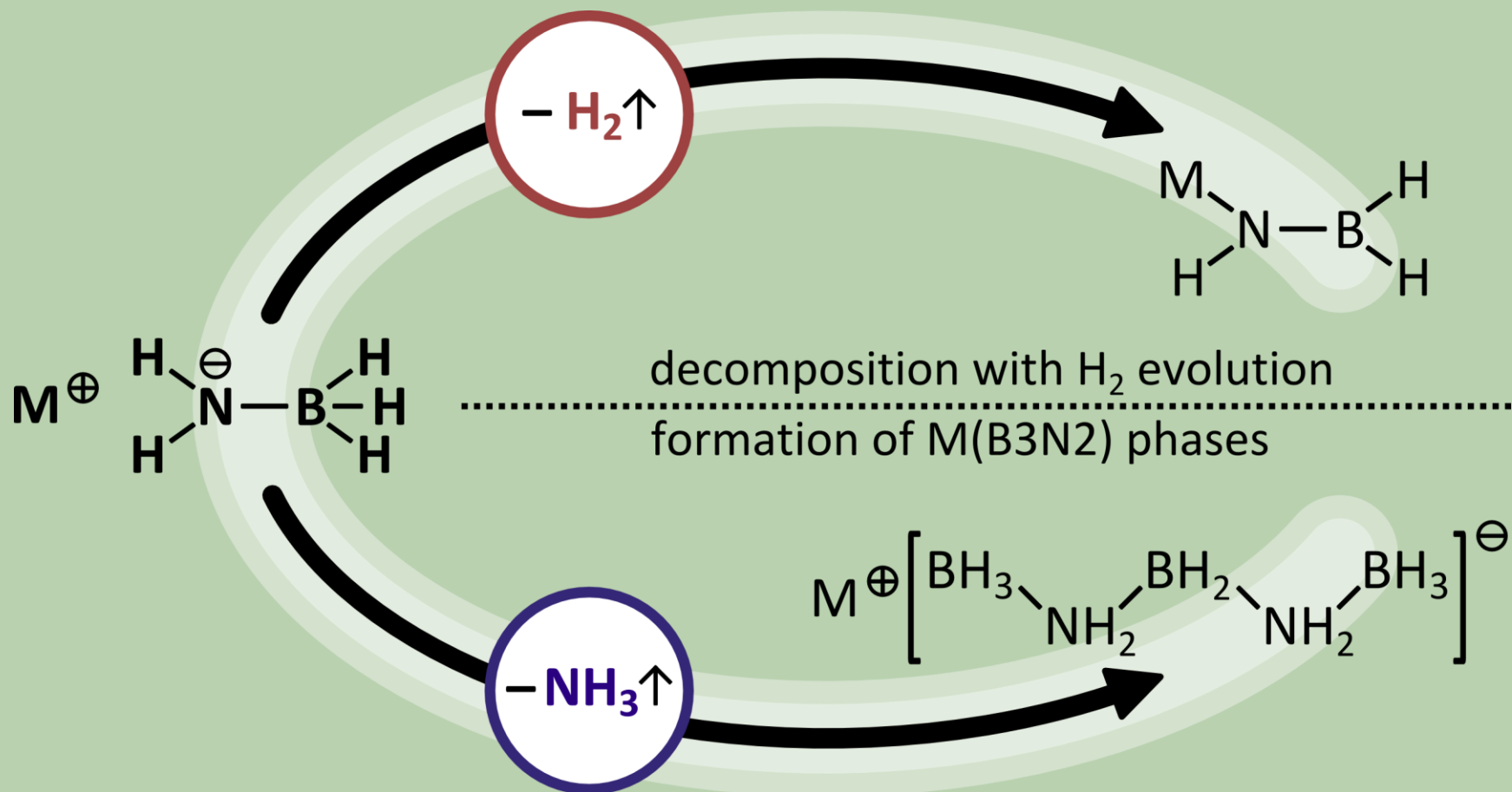


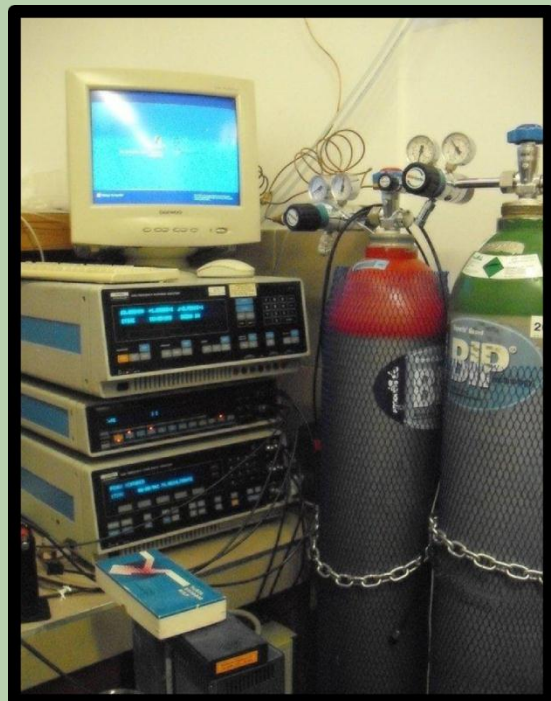
ammonia borane





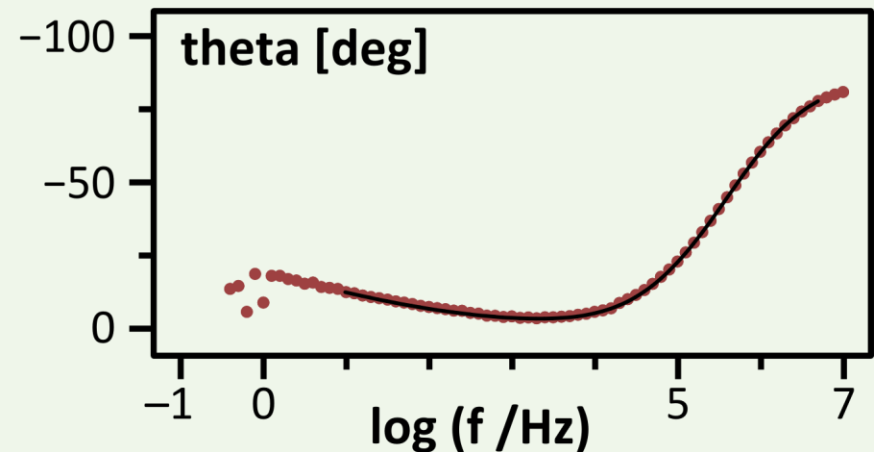
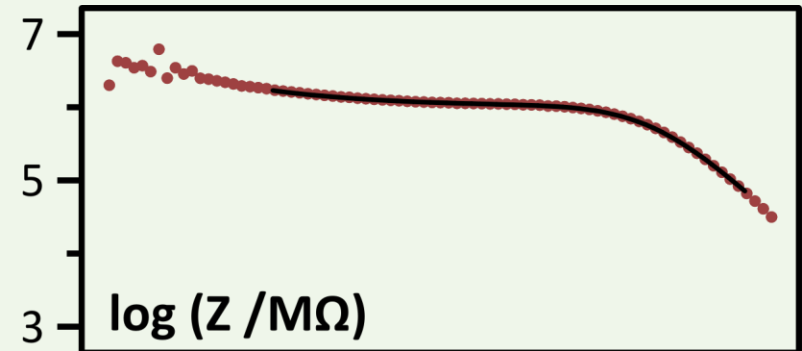
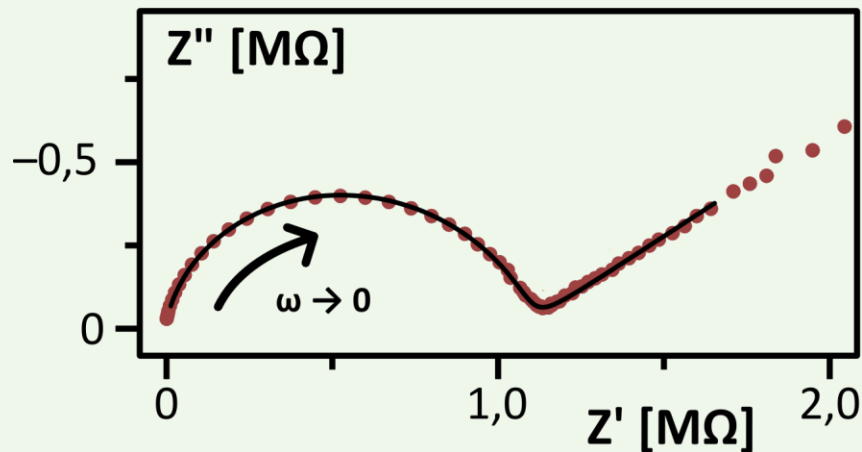
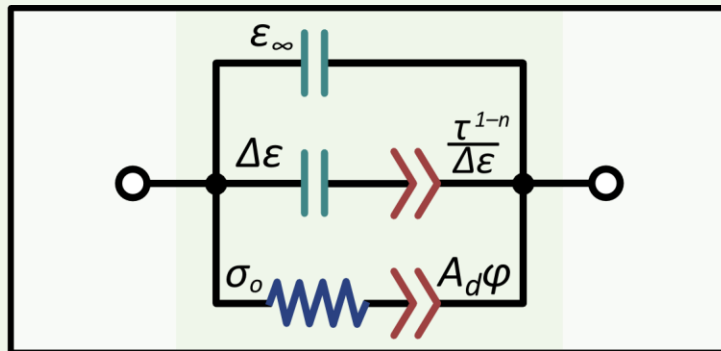
- desorption of hydrogen – known mechanism
- desorption of ammonia – we needed more evidence





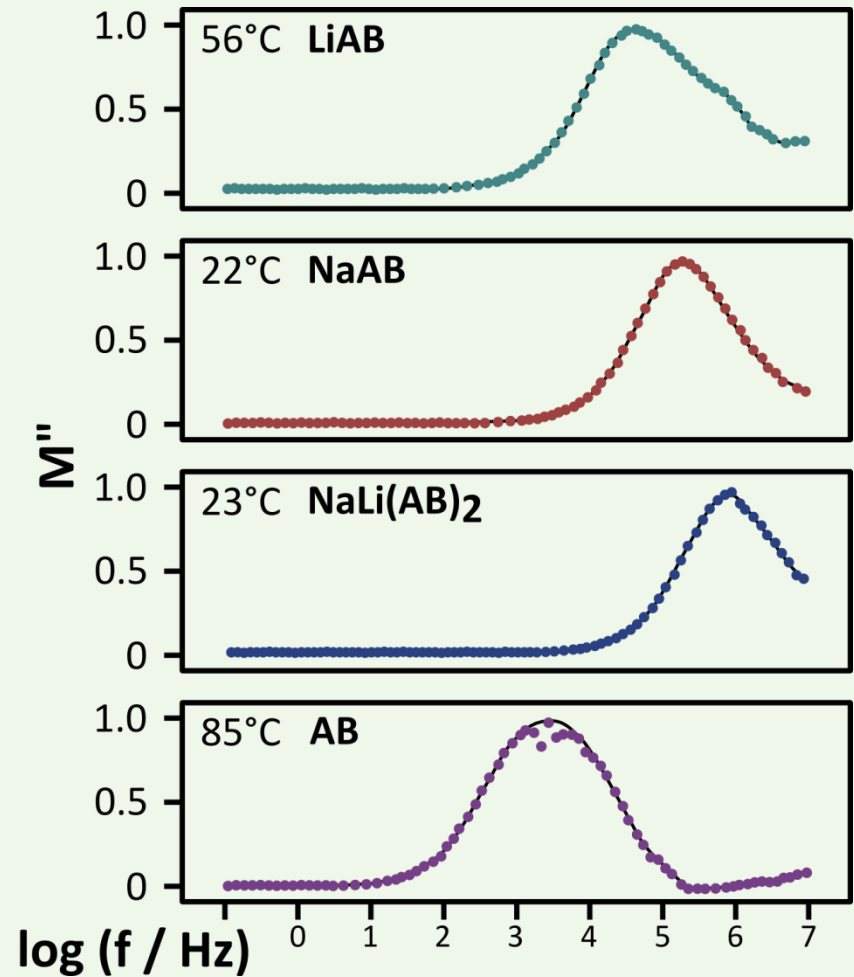
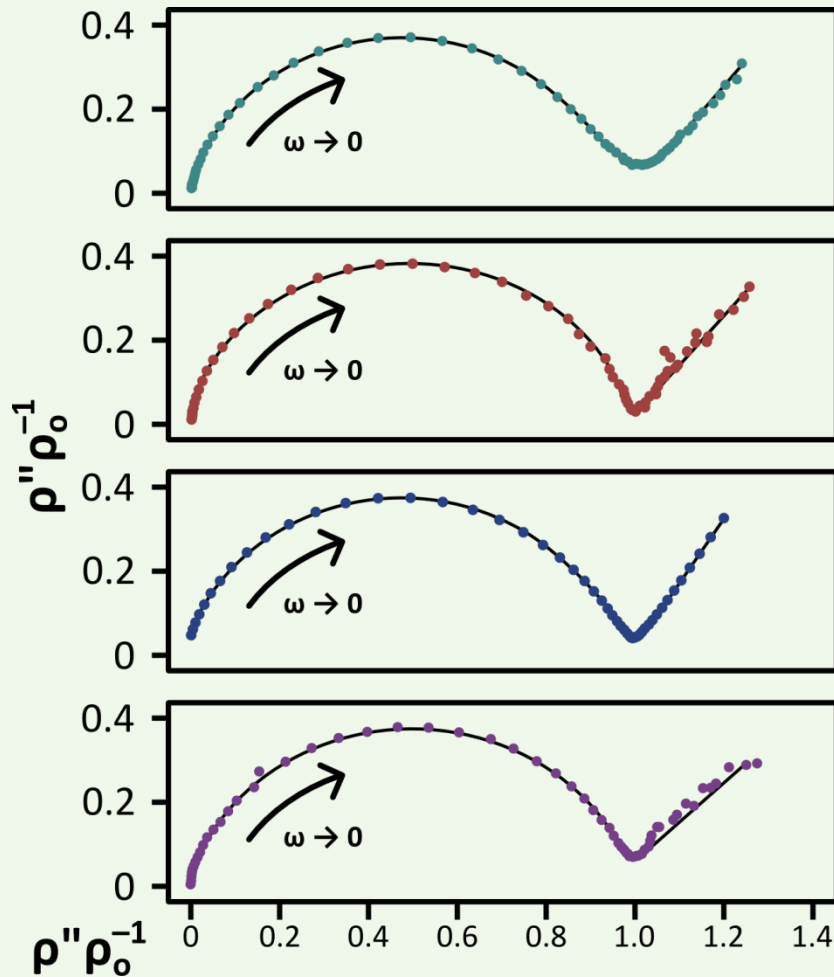
- modified Cole–Cole model, purely ionic conductivity
- relatively high conductivity ($\sigma = 2.3 \text{ mS/cm}$)

equivalent circuit
for NaAB





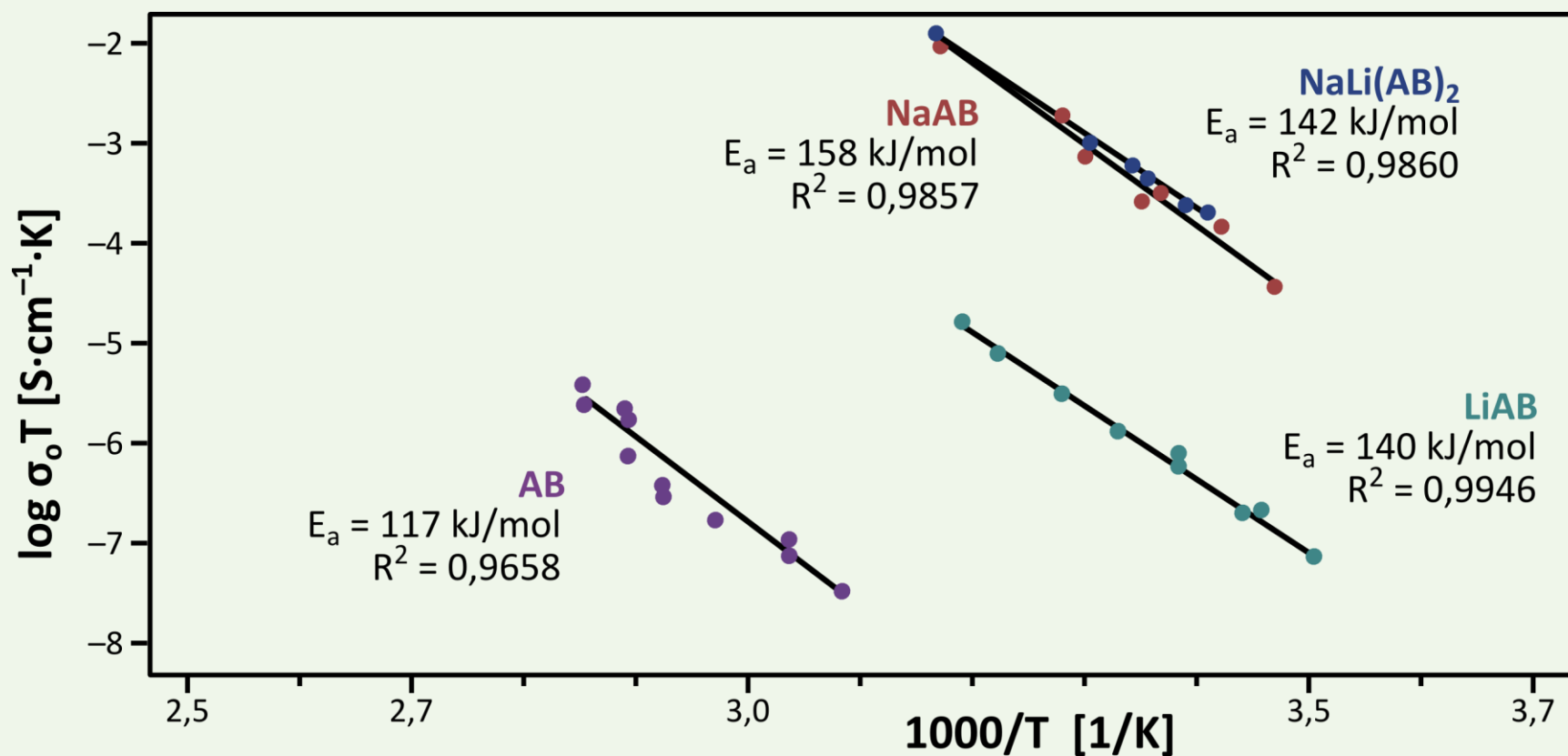
similar behavior for LiAB, NaAB, NaLi(AB)₂ and AB





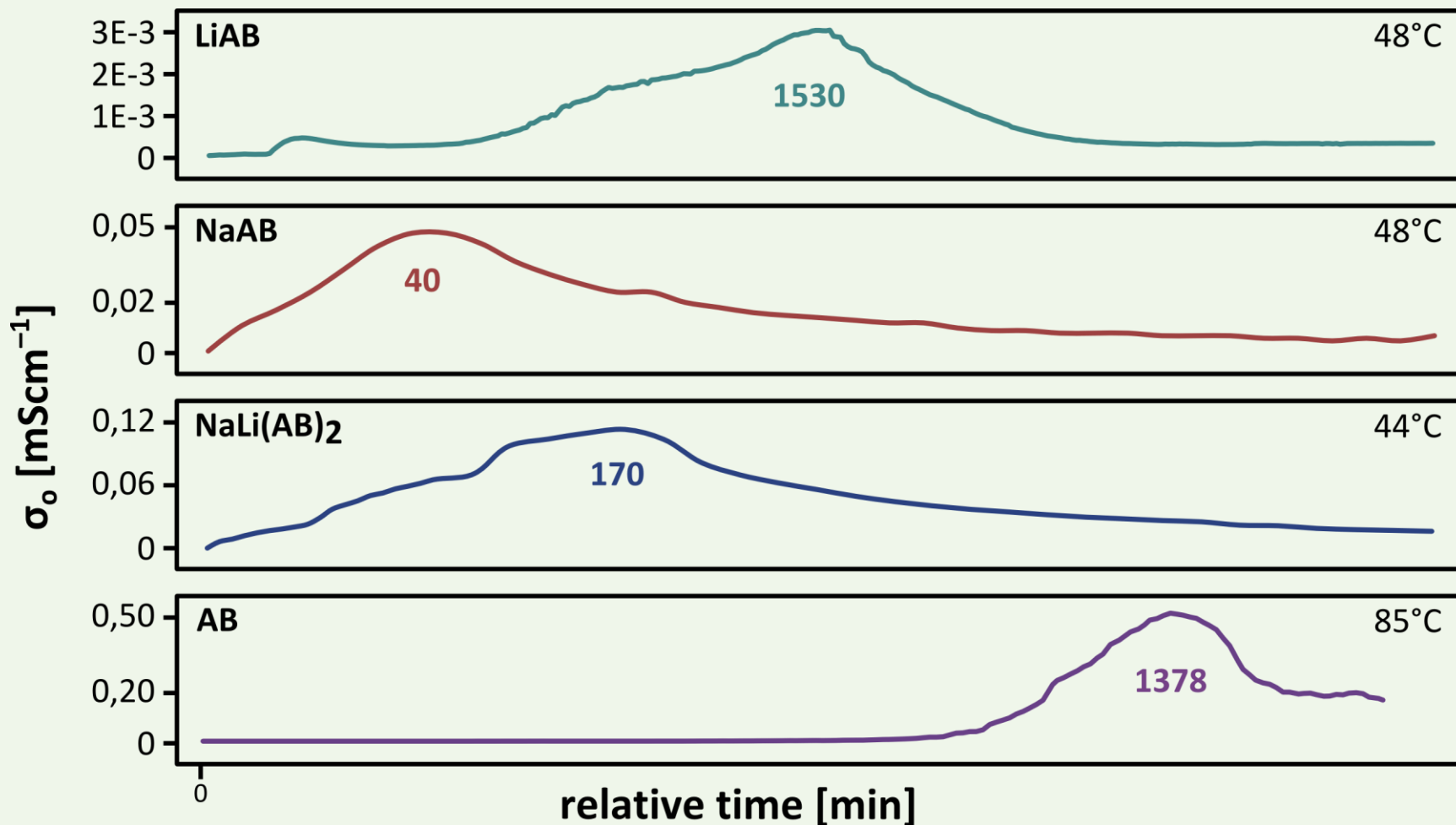
activation energy

- the same order of E_a – similar conductivity mechanism
- conductivity of **NaAB** and **NaLi(AB)₂** almost identical

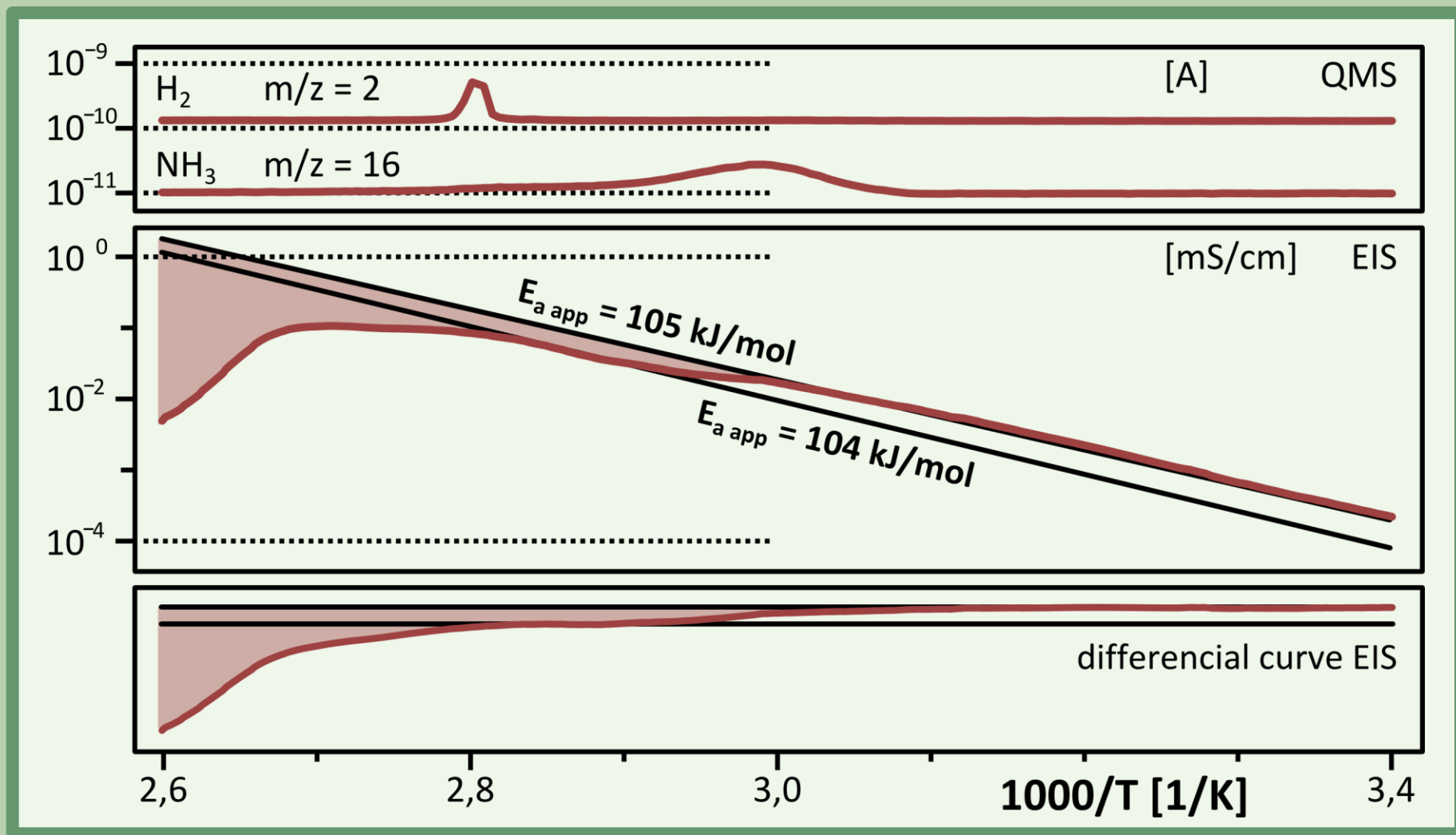




inflection for LiAB, NaAB, NaLi(AB)₂ and ammonia borane

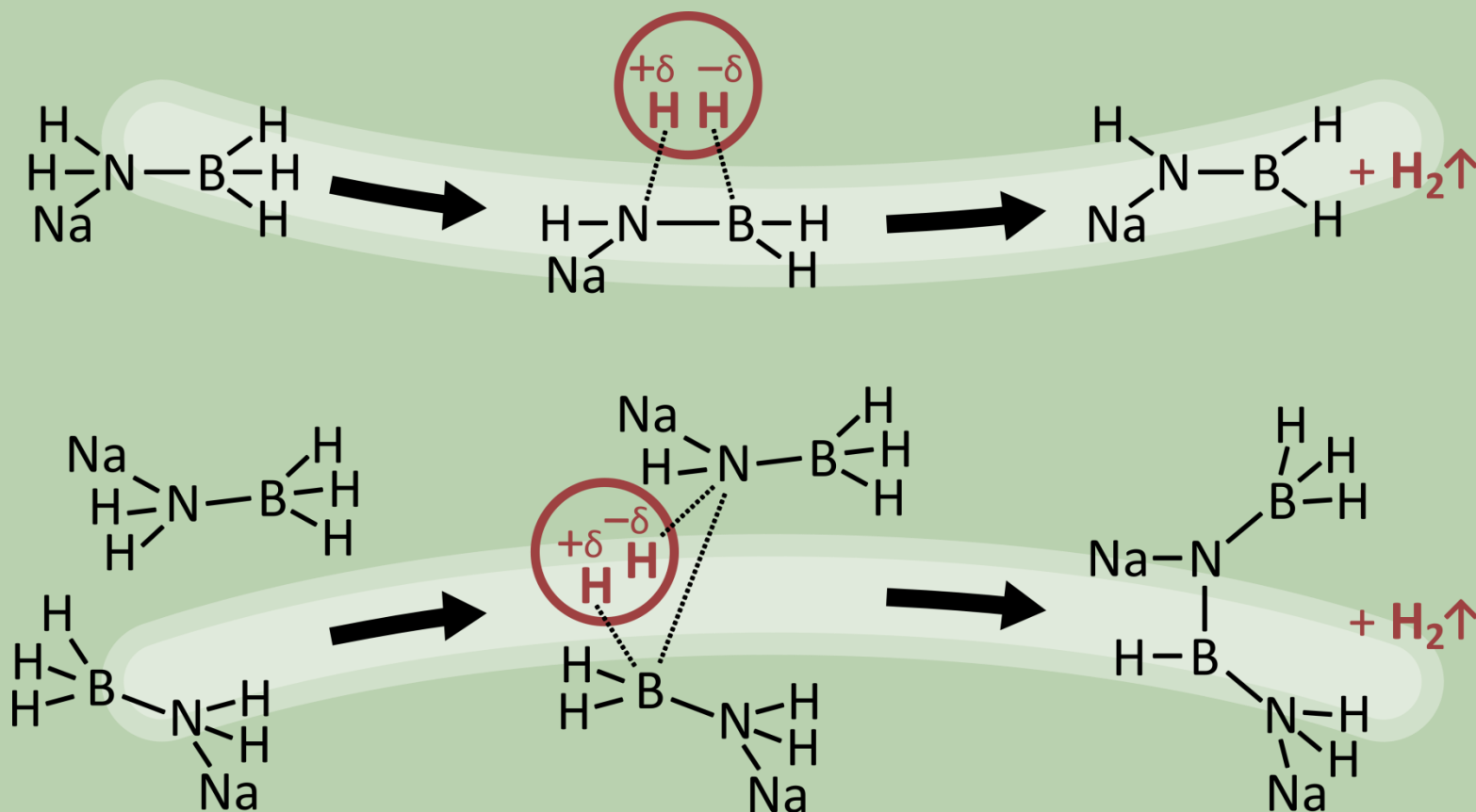


inflection points correlated with evolution of ammonia



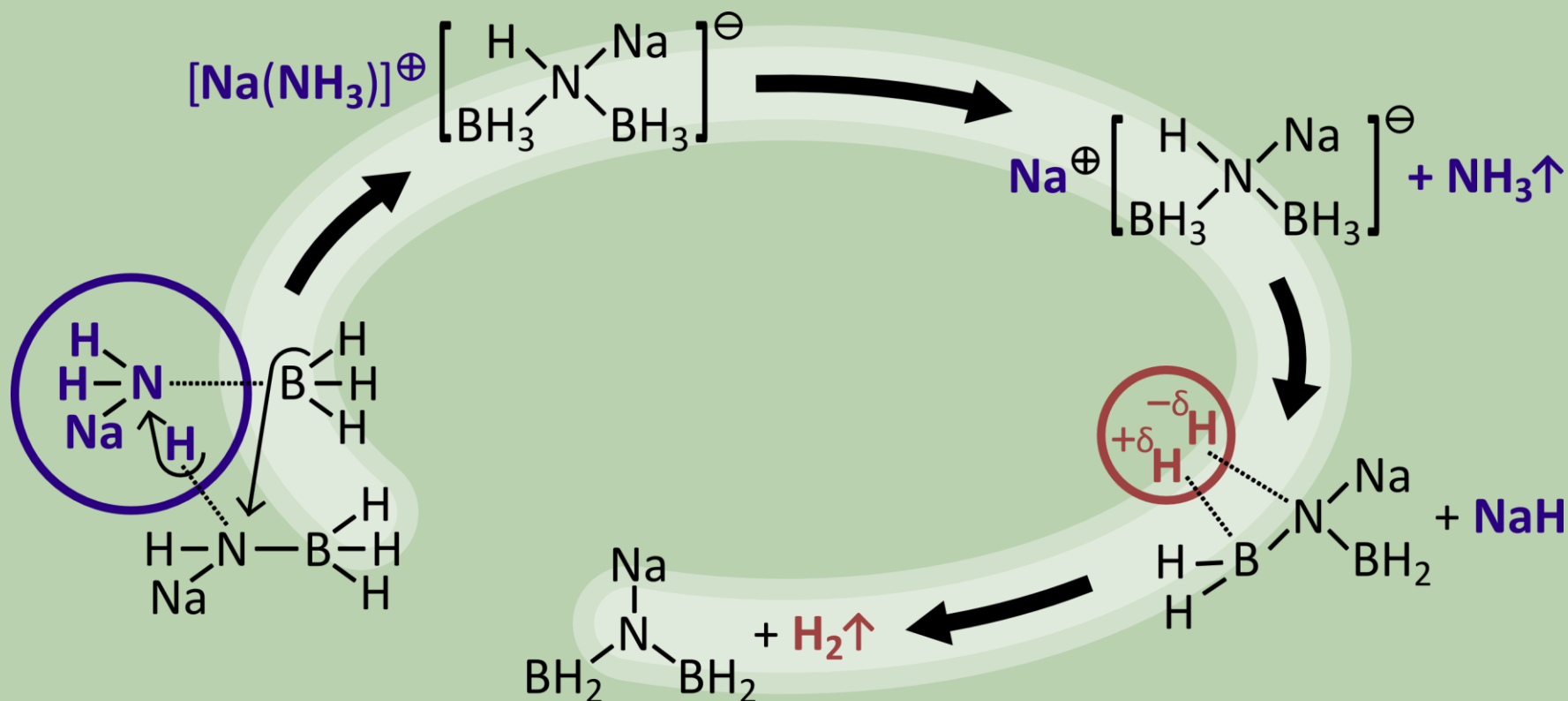


- recombination of H^+ and H^-
- occur for all alkali metal amidoboranes



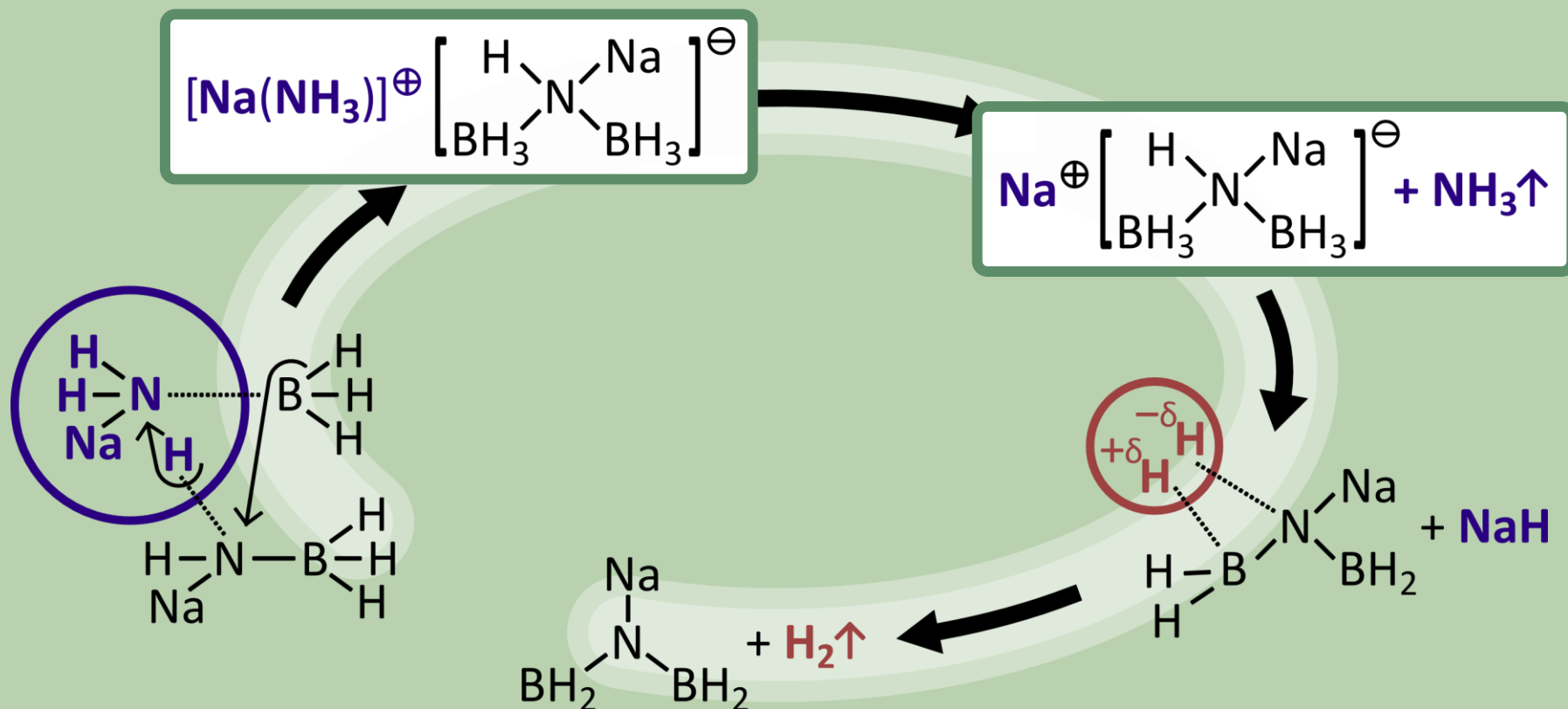


- intermolecular transformation: up to 10–15% of a sample
- possible only for LiAB, NaAB, NaLi(AB)₂





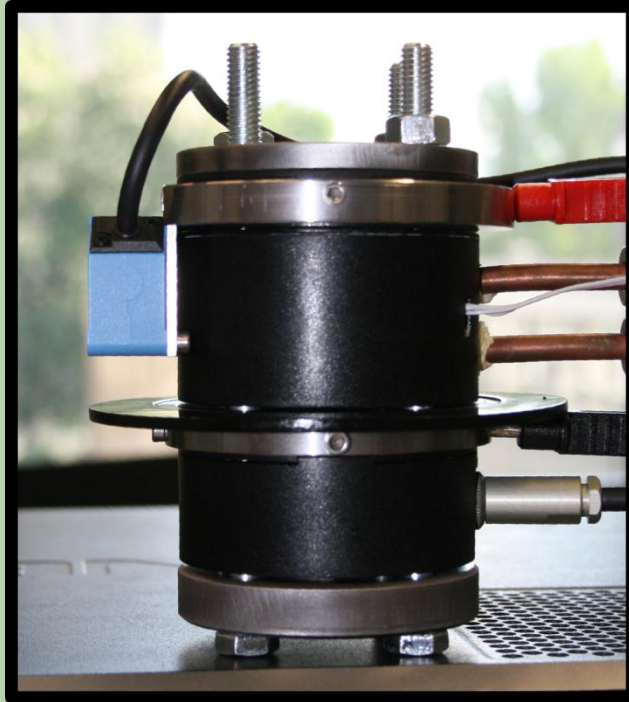
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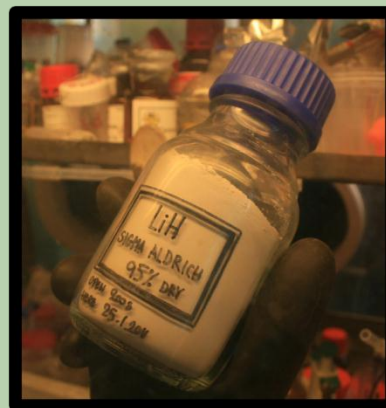
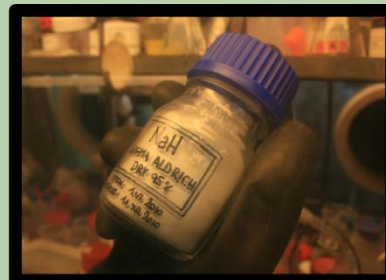
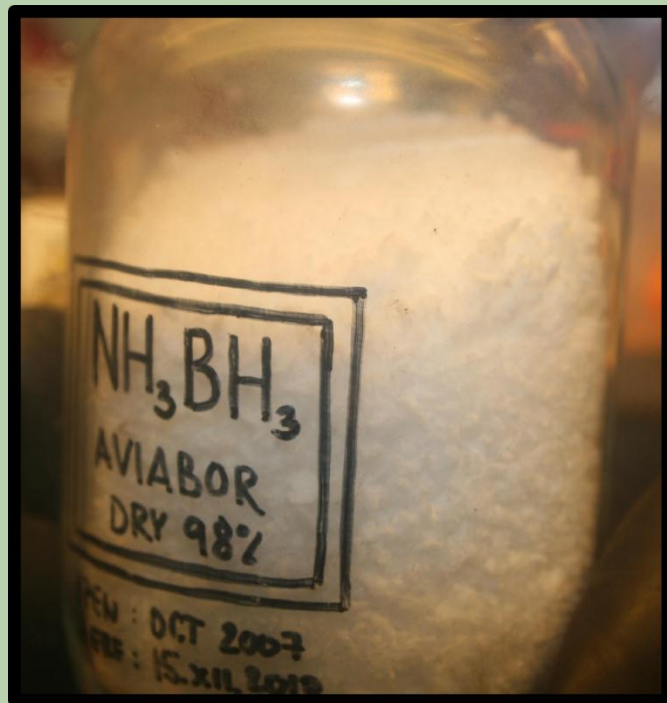


Karol
Fijałkowski

impedance JAWS

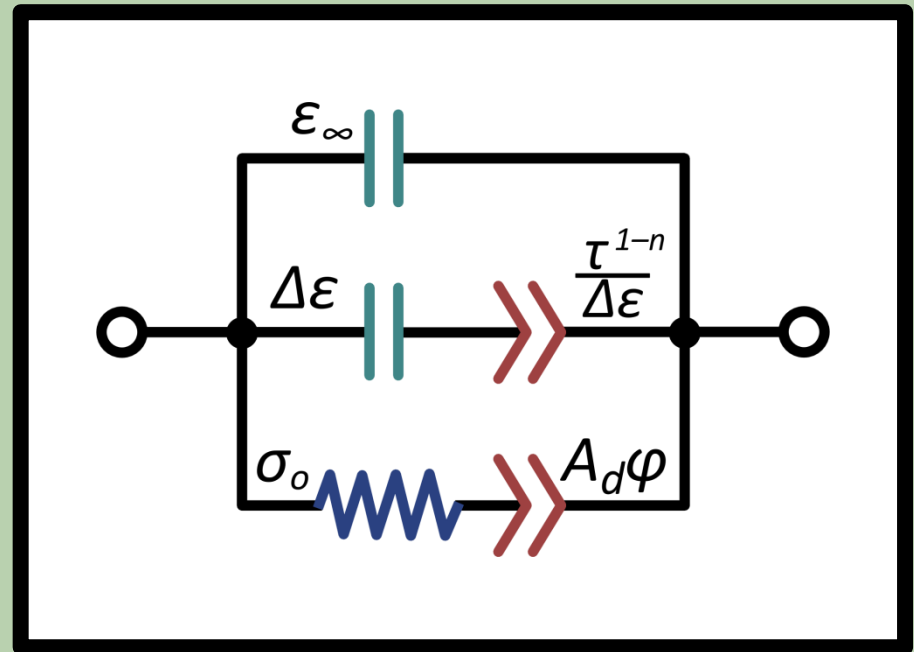
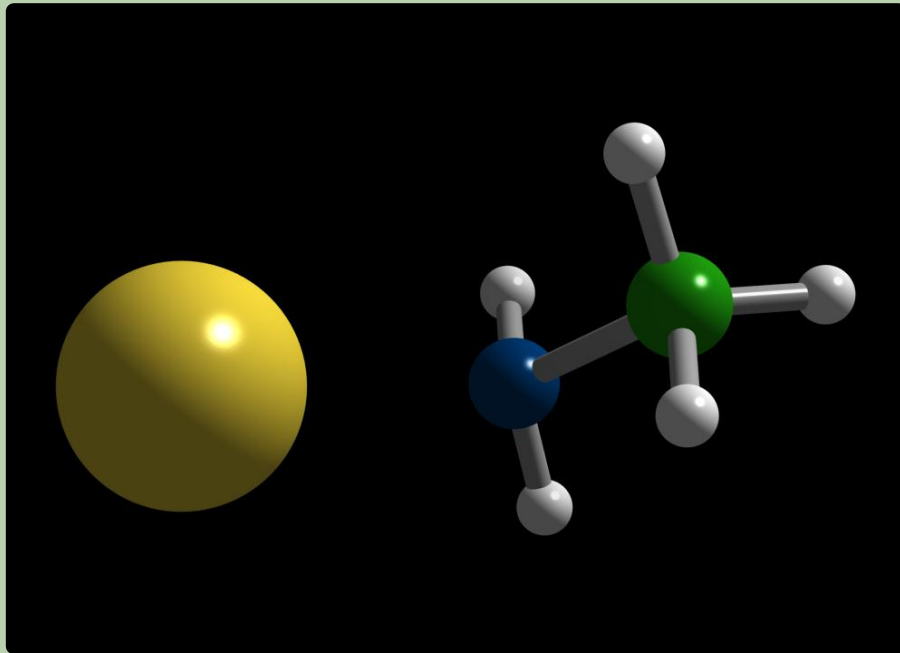


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conductivity of alkali amidoboranes:

- high ionic conductivity
- detected intermolecular transformation
- confirmation of the proposed mechanism



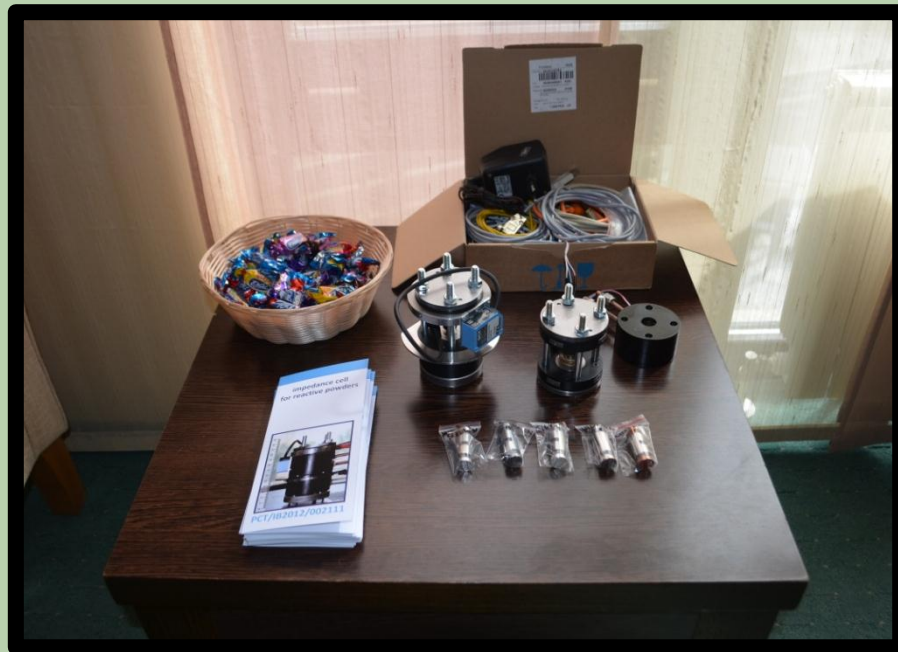


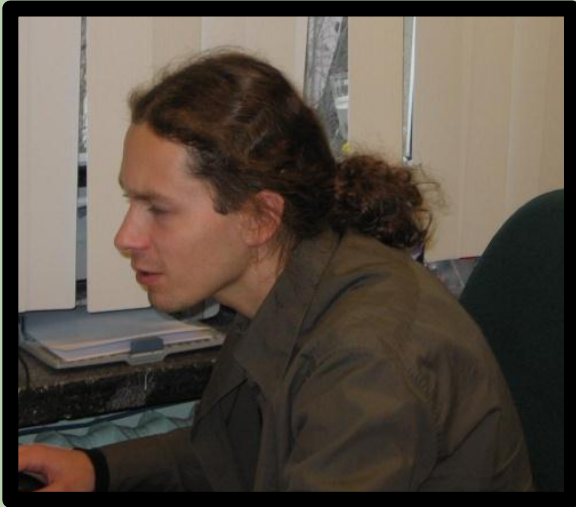
Ministry of Science and Higher Education

120000-501/59 PM-117

EU 1.3.2. program

POIG.01.03.02-00-133/11-00





Thank you for your attention