Hydrogenation of model compounds with nickel carbide and phosphide in mild conditions

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Why nickel-containing nanoparticles for hydrogenation catalysis?

- Ni(0) are excellent catalysts for alkene/carboxyl/nitrate/nitrile moieties
  BUT poorly selective, air-sensitive and poisoned by nitrogen/phosphorus/sulfur/CO
- Needs for modified nickel catalysts: carbides and phosphides!
- Colloidal syntheses via thermal decomposition of Ni(acac)₂ and C/P insertion

Carbidization and subsequent phosphidization of Ni(0) nanoparticles

- One-pot two steps synthesis of Ni₃C, Ni₅P and Ni₁₂₂₅₅ P₃ unsupported nanoparticles

X – ray absorption spectroscopy (XAS)

- Spectra identical to the reported ones in literature
- Covalent character of the nickel carbides and phosphides
- Extension of the Ni – Ni bond upon insertion of C and P atoms

Conclusions

- Successful synthesis via a solvothermal reaction of a family of unsupported nanoparticles (carbide Ni₃C and phosphides Ni₅P / Ni₁₂₂₅₅ P₃) presenting similar morphologies
- Characterization of the catalysts by XAS: in agreement with literature
- First catalytic results on nitrobenzene and phenylacetylene hydrogenation

Perspectives

1. COMPARATIVE STUDY WITH Ni₅P AND Ni₁₂₂₅₅ P₃
2. EXTENSION TO OTHER FUNCTIONAL GROUPS (carbonyl, nitrile, furfural)
3. ADDITION OF A CO-CATALYST (amines, phosphines)

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