Organometallic Chemistry and Cryogenic Capacities

Decades of experience in boronic acids, highly selective reductions, and Li/Mg/B chemistry

Setup

- The largest cGMP capacity for cryogenic reactions: > 200 m^3 cryogenic reactor volume
- Reactions down to – 80 °C
- 500 l to 8 m^3 reactors
- Glass lined and Hastelloy
- Up to 10 bar
- OEL down to 0.1 µg/m^3
- Batch mode and continuous processing
- Highly flexible setup with more than 50 reactors with cryogenic capacities
- Organometallic reactions at three sites

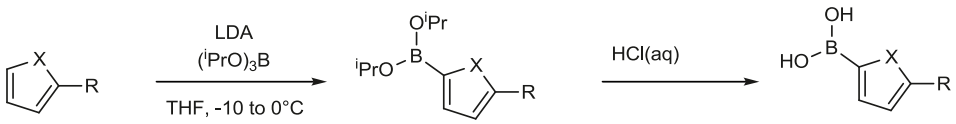
Reaction types

- Decades of experience in organometallic and cryogenic chemistry including
- Grignard reactions
- Lithiations: LDA, BuLi, HexLi, etc.
- Reductions: LAH, DIBAH, BH_3, 9-BBN, etc.
- Aromatic/heterocyclic boronic acids
- Sensitive reagents (ZnEt2 etc.)
- Transmetallations
- Highly exothermic reactions
- Chemistry in Water

Special technologies

- Grignard in continuously stirred tank reactor cascades
- Loop reactors
- Large cryogenic high potent capacities
- Precious Metal Recovery at Tippecanoe
- Sustainability Aspects

Example 1: Boronic acid formation in a loop reactor



- Cost Improvements via Precious Metal Recovery at Tippecanoe for large scale productions
- Membrane Filtration Technology enables Recovery of precious Metals from organic waste streams
- Sustainable Technology with Significant Cost Improvement

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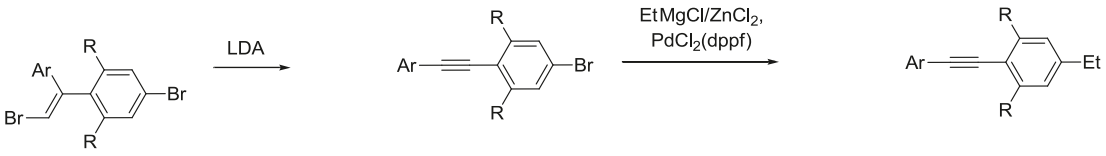
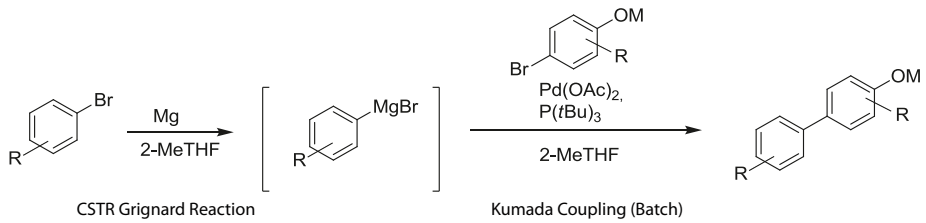
Example 2: Rearrangement followed by Negishi coupling



- Handling of Grignard and organic Zinc compounds (implemented at ton scale)
- Highest purity requirements
- Involves continuous step
- More than 10 years experience in commercial production

Example 3: Continuously stirred tank reaction to produce an API intermediate (600 kg scale)



CSTR Grignard Reaction

Kumada Coupling (Batch)

- Grignard run as continuously stirred tank reaction in 100 l reactor
- Manufactured several t of Grignard solution

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