Bio-inspired/Water activated Systems for CO_2 capture

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1st Workshop
CO_2 SEQUESTRATION AND UTILIZATION at REQUIMTE

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LAQV REQUIMTE

Introduction

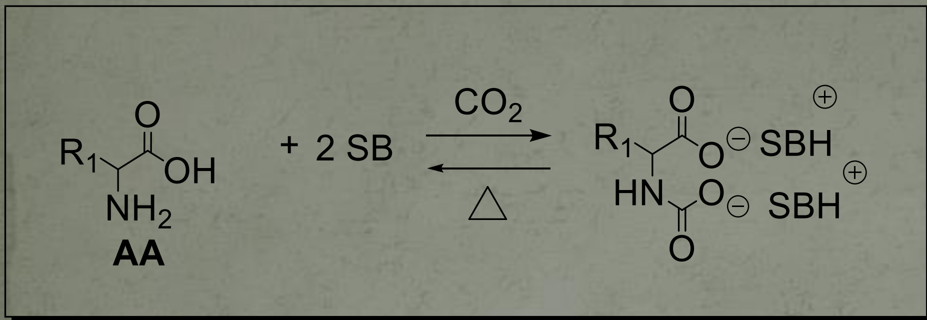
- In the present environmental and energetic context frameworks for CO_2 capture are highly sought.

- Commercial systems in the market available for more than 60 years – Aqueous solutions of alkanolamines

- Major drawbacks:
  1. Requirement of dilution of the capture agent in water (in order to avoid corrosion and mitigate excessive release of heat during reaction)
  2. Moderate performances in CO_2 capture (7 wt% of CO_2 uptake in 30% aqueous solution of ethanolamine)
  3. High energy demand for CO_2 stripping, due to the high heat capacity of water.
  4. Additionally, the solvent is lost during operations

Is here presented alternative CO2 capture systems based on compounds from chiral pool, cheap carboxylic acids and organic superbases

Reversible Systems Based on CO2, Amino-acids and Organic Superbases



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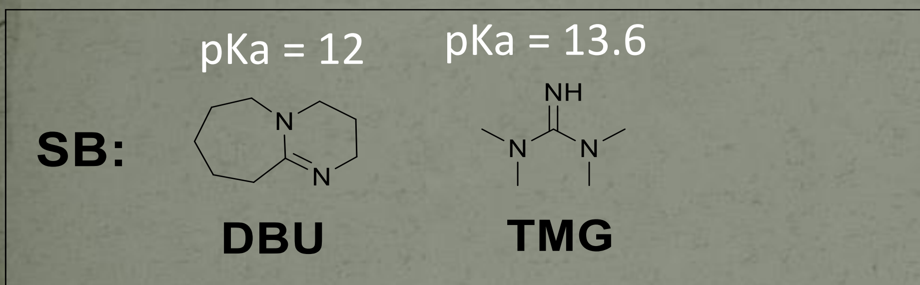
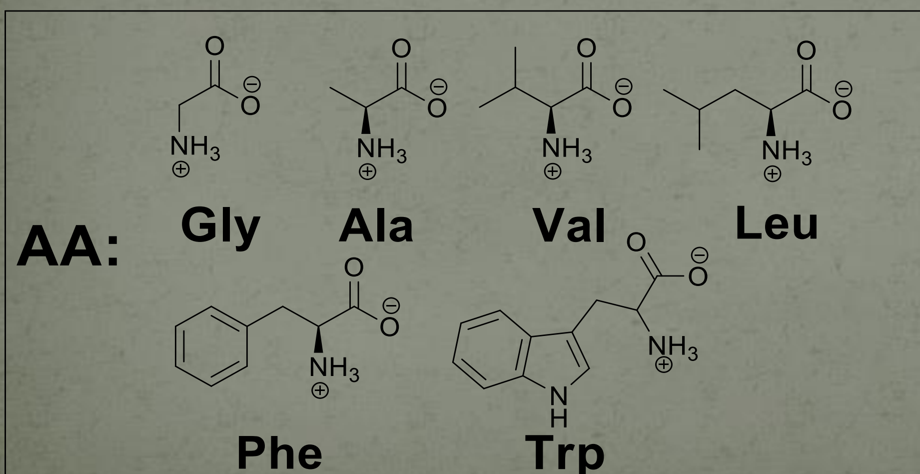
RSC Adv., 2015,5, 35564-35571



Organic superbases



Aminoacids from chiral pool

Main Results

Compound	T_d (ºC)
$[TMGH^+]_2$ $[GlyCOO^-]$	> 120
$[DBUH^+]_2$ $[GlyCOO^-]$	106.36
$[TMGH^+]_2$ $[AlaCOO^-]$	> 88
$[DBUH^+]_2$ $[AlaCOO^-]$	101.77
$[TMGH^+]_2$ $[ValCOO^-]$	> 120
$[DBUH^+]_2$ $[ValCOO^-]$	96.35
$[TMGH^+]_2$ $[LeuCOO^-]$	109.07
$[DBUH^+]_2$ $[LeuCOO^-]$	95.6
$[TMGH^+]_2$ $[PheCOO^-]$	93.79
$[DBUH^+]_2$ $[PheCOO^-]$	86.91
$[TMGH^+]_2$ $[TrpCOO^-]$	> 74
$[DBUH^+]_2$ $[TrpCOO^-]$	79.62

- Amino-acid based carbamate salts were succesfully prepared using CO2 and an Organic Superbase.

- For DBU based salts, as the size of R- group of the amino-acid increases the value of T_d , associated to CO_2 release, decreases.

CO_2 Capture systems based on saccharides and organic superbases

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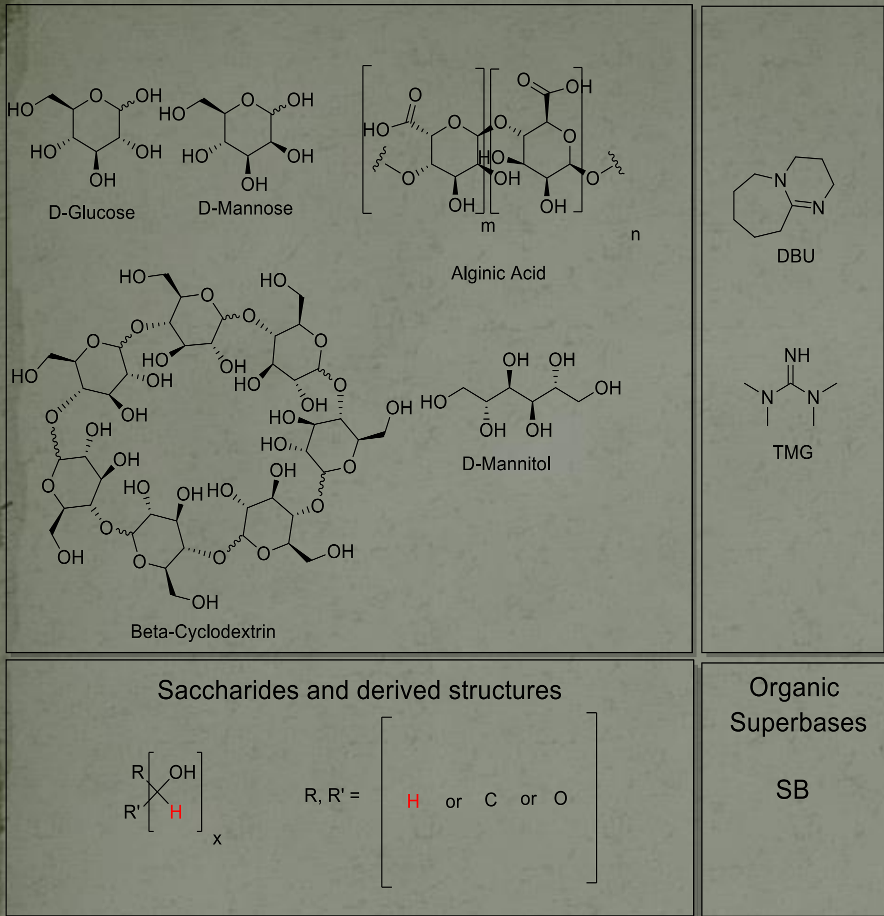
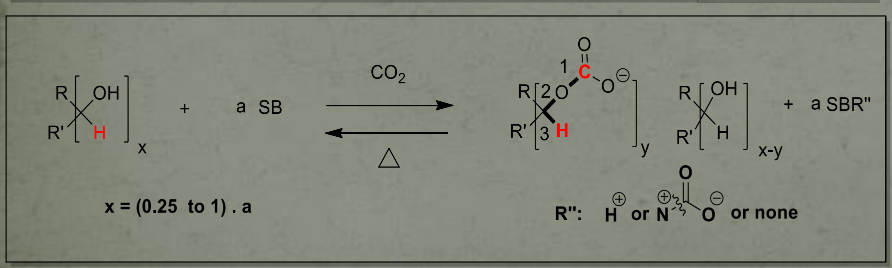
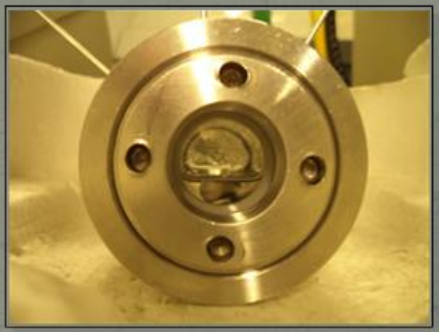
Faraday Discuss., 2015,183, 429-444



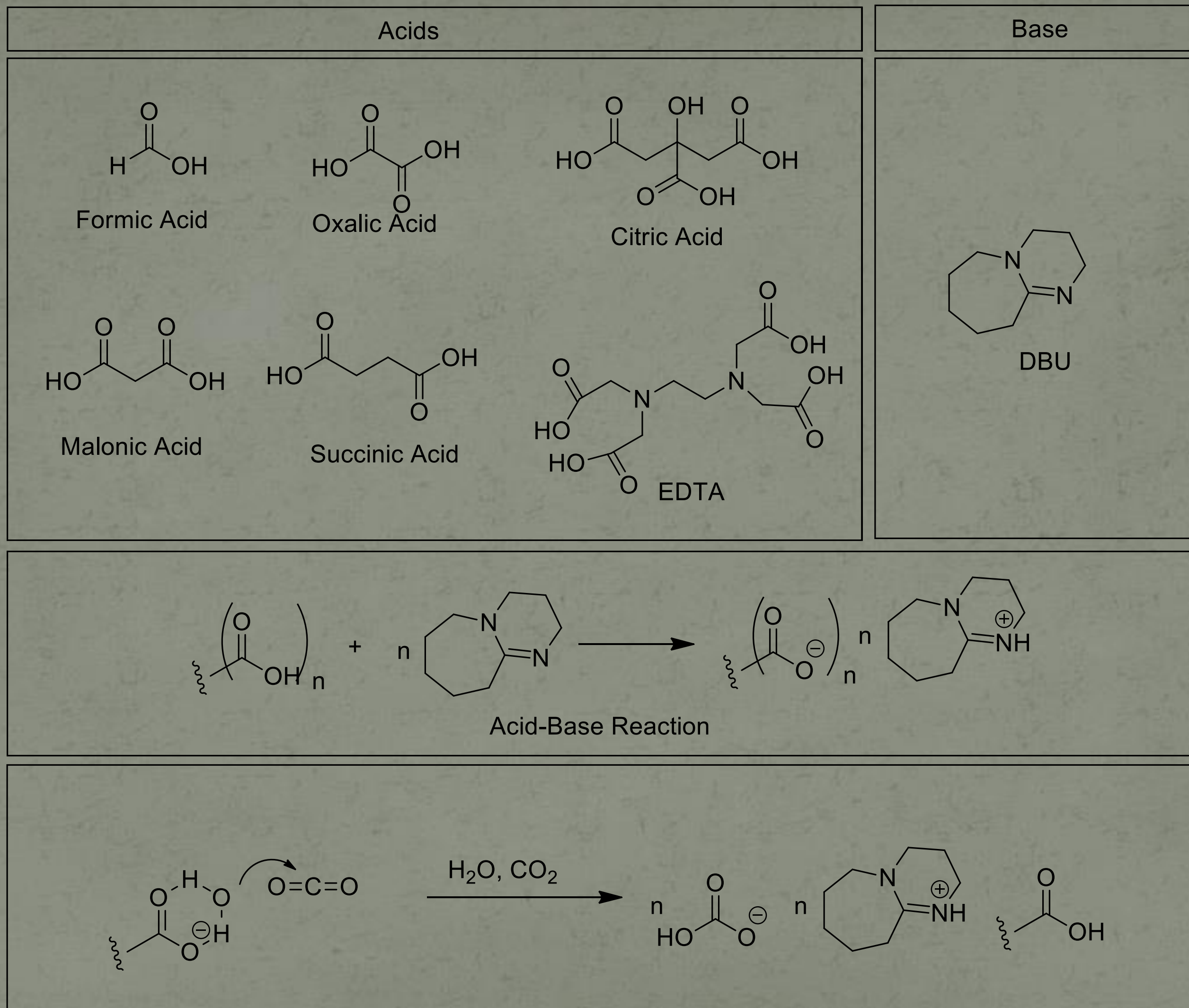




- Best performance: D-Mannose:DBU (0.625:1 in equivalents) → 13.9 wt% of CO_2 uptake and 3.3/5 alcohol groups to carbonates.
- Energy Requirement for CO_2 strip →(2790 kJ/kg CO_2)

  Benchmark system→ (3873 kJ/kg CO_2).

Aqueous Carboxylic Acid-Based Solutions for CO_2 Capture



In progress...

Acknowledgments

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