

Capture and Separation, the First Step toward Circular Economy; a Regenerable, Bio-Based, Polymerized, Ionic Liquid Membranes

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## B.15 CO<sub>2</sub> Capture and Separation, the First Step toward Circular Economy; a Regenerable, Bio-Based, Polymerized, Ionic Liquid Membranes

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Air can be considered as a source of CO<sub>2</sub>, with concentrations of approximately 408 ppm reported in 2018 and predicted levels expected to reach 600–1550 ppm in 2030. Direct air capture (DAC) from the atmosphere is considered as a CO<sub>2</sub> separation technology that can be realized and a source of CO<sub>2</sub> exploitable as building block for utilization. The use of solid amines for CO<sub>2</sub> adsorption following a two-steps process: the adsorption of CO<sub>2</sub> from the direct air and the separation of CO<sub>2</sub> from the sorbent. The separation of CO<sub>2</sub> from amines is relatively easier than from strong liquid bases as it requires less energy due to the weaker bonds between CO<sub>2</sub> and the solid sorbent. The benefit of the DAC technology is that it can be implemented anywhere because of the fast mixing of CO<sub>2</sub> in the air. However this technique rely on the preparation of amine sorbed on solid inorganic substrate such as silica substrate and even if durable are quite difficult to regenerate once spent. Our substrate is based on polymerized ionic liquid that use as functional amino acid anions as active sorbent.

Ionic liquids (ILs) are organic salts that melts below 100°C been studied as innovative material for CO<sub>2</sub> capture. Polymerized ionic liquids (PILs) merge ILs and macromolecules peculiarities resulting in a novel class of material that features high tunability and ionic exchange ability as well as easier handling, processability typical of polymer. PILs have been studied for gas separation and demonstrated, higher CO<sub>2</sub> loading than common ILs, as well as faster absorption/desorption rate. However, despite the chemical absorption of CO<sub>2</sub> in ILs is a well-established concept divided as capture by chemisorption or by physisorption in PILs the majority of the studies focus on material without CO<sub>2</sub> reactive species and no explicit reference to chemical nor physical sorption materials.

Different PILs with amino acid anions were developed and tested for CO<sub>2</sub> absorption in solid phase. The research on PILs aimed to explore different AA anions as well as different polymeric structures. Ionic exchange procedures were tuned depending on the solubility property of the starting PIL with several AA. All synthetic procedures aimed to avoid toxic and hazardous chemicals. Obtained PILs were identified and were tested for CO<sub>2</sub> and water absorption and desorption.