CO_2 REMOVAL FROM ANAESTHETIC CIRCUITS

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In typical anesthesia processes, a gas mixture composed by 70% of nitrous oxide (N_2O), 30% of oxygen and 1-8% of halogenated hydrocarbons (HHCs) is administrated to patients. After the patient exhales, the carbon dioxide (CO_2) (approximately 5%) should be removed to values down to 0.5% in order to be possible to recirculate it to the patient. Although N_2O is the most common gas used in anesthesia, there are significant medical advantages on the use of Xenon.[1] However, the main limitation for the generalized use of Xenon in anesthesia processes is its high cost. The usual technology for capturing CO_2 from an anesthesia circuit is based on soda lime, which presents some disadvantages, such as, the possibility of reaction with anesthetic agents and production of toxic compounds. Thus, it is necessary to replace soda lime, which represents an expensive cost for the hospital, and develop efficient and compact separation technologies for capturing CO_2 from anaesthetic gas streams.

This work proposes an innovative process for efficient removal of CO_2 from anesthetic gaseous streams of Xenon, using supported ionic liquid membranes that combine the ability of ionic liquids (ILs) to solubilize CO_2 with the use of the enzyme carbonic anhydrase, which catalyzes the conversion of CO_2 to bicarbonate, as can be observed in Figure 1.

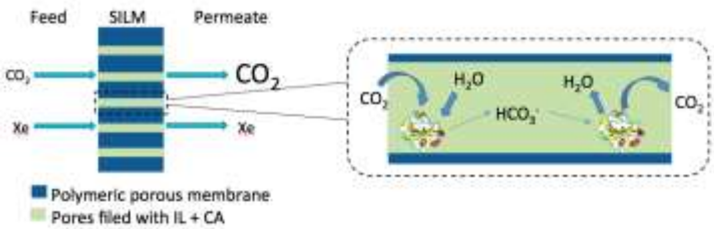

Figure 1. Schematic representation of the proposed concept.

CO_2 and Xe solubility and diffusivity coefficients in different pure ionic liquids and ionic liquids containing carbonic anhydrase enzyme in a very low concentration ($0.1mg_{enzyme}/g_{solvent}$ and $1mg_{enzyme}/g_{solvent}$) were determined at 30ºC. Due to the fact that the biocatalytic activity is very sensitive to enzyme hydration, the water activity of the solvent was controlled. The results obtained showed that, depending on the water activity of the ionic liquids, the CO_2 solubility coefficient increased up to 30%, even for the low enzyme concentration used.[2] Supported liquid membranes containing ionic liquid and ionic liquid with enzyme were also prepared, and CO_2 and Xe permeability was measured at 30ºC. It was observed that both CO_2 permeability and CO_2/Xe ideal selectivity is higher when the enzyme is present.

Future work will consider the use of hollow fiber membrane contactors, in contrast with the flat geometry of supported ionic liquid membranes, due to their high specific area, enabling the development of compact medical devices for recycle of anesthetic gases.

References

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