Electrochemical method for CO2 Capture by Electrical Double Layers by means of capacitive deionization

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The climate crisis affecting our planet, and its relationship with the accumulation of greenhouse gases in the atmosphere, particularly CO2, has led to a growing interest in methods for removing carbon dioxide from the atmosphere. Here we highlight the use of electrochemical methods [1] based on the properties of electrical double layers, in particular those generally known as Capacitive Deionisation (CDI) technologies. These are characterised by the capture of ions from solution and their incorporation into the electrical double layers of capacitive electrodes (activated carbon is mostly used) or intercalated in battery electrodes. The use of ion-exchange membranes bonded to the electrodes is also common (membrane CDI or MCDI). Although the method can be used for direct gas capture [2], it is easier to perform a prior dissolution of the CO2/carrier gas mixture in water or a solution and perform indirect CO2 removal by adsorption of HCO3(-) [3]. In this communication, we present data on the adsorption of CO2 in aqueous solutions using polyelectrolyte-coated carbon electrodes, which is known as soft electrode capacitive deionisation (Soft-CDI) method [4]. Additionally, the interposition of ion exchange membranes (SE-MCDI) is shown to increase significantly the removal of dissolved carbon dioxide. Figure 1 shows some results in the form of electrical conductivity differences (outlet minus inlet conductivities) as a function of time for alternate positive and negative cell potentials. It should be noted that the application of positive current (favourable to the uptake of HCO3(-) anions by the cationic polyelectrolyte (PDADMAC)-coated electrode and of H+ cations by the PSS (anionic)-coated electrode) reduces the conductivity, indicating the removal of ions from the solution. The opposite is observed when the current is reversed. These data make it possible to evaluate the amount of CO2 captured and the efficiency of the process.

Keywords:
Capacitive deionization, Carbon dioxide capture, Electrical double layer

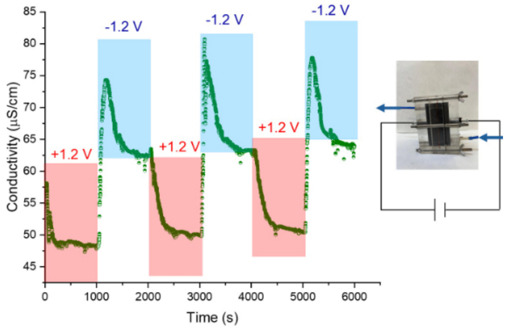

Figure 1. Conductivity of the exit solution (CO2-saturated water) as a function of time for the indicated cell voltages of a soft-electrode CDI system.

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