研究論文

濃厚電解質水溶液におけるキノン系化合物の電気化学的酸化還元を利用した二酸化炭素の捕捉・放出技術の検討

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Investigation of Carbon Dioxide Capture and Release Technology Utilizing Electrochemical Oxidation-Reduction of Quinone Compounds in Concentrated Electrolyte Solutions

by

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Abstract

This study investigates the electrochemical CO_2 capture and release behavior of 9,10-anthraquinone (AQ) and its derivatives in highly concentrated aqueous lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) solutions. AQ dissolved in LiTFSI concentrations above 4 M and exhibited reversible redox behavior, particularly in 5 M LiTFSI, where Li^+ and $TFSI^-$ adsorption is considered to enhance electron-transfer kinetics. Substituent-dependent shifts in redox potentials were consistent with those observed in $TBAPF_6$/DMSO. Under CO_2-saturated conditions, halogenated derivatives such as 1-chloroanthraquinone (ClAQ) showed significant current increases and peak shifts, indicating effective CO_2 binding. Charge analysis revealed higher reversibility in concentrated LiTFSI than in the nonaqueous electrolyte. Color changes upon CO_2 introduction into reduced AQ solutions further confirmed CO_2 capture. These results demonstrate that concentrated LiTFSI aqueous solutions provide a safe and efficient medium for quinone-based electrochemical CO_2 separation.

Keywords: Lithium bis(trifluoromethanesulfonyl)imide, Electrolyte-concentrated aqueous solution, Carbon Dioxide Capture and Release, 9,10-anthraquinone

1. 緒言

近年, 人為起源の二酸化炭素（CO_2）排出量の増加に伴い, 地球温暖化や気候変動が深刻な問題となっている [1]. これに対し，排出源から CO_2 を回収し，有効利用または貯蔵する技術の開発が強く求められている [2]. 特に，電気化学的手

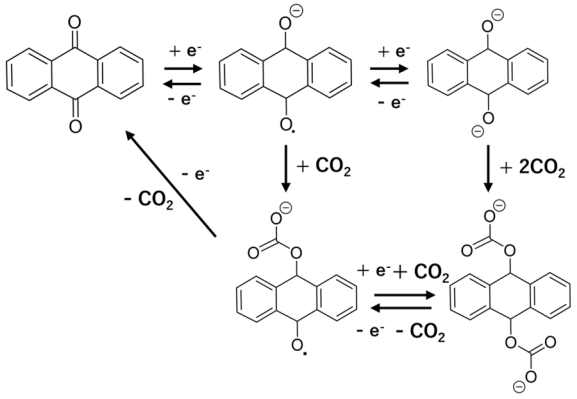

Fig. 1 Diagram illustrating the reaction mechanism of CO_2 capture and release associated with the oxidation-reduction of AQ.

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