CO_2 Adsorption on Copper Catalyst as Enhanced by Ion Liquid

G. Chikvaidze[1], J. Kleperis[1], G. Vaivars[1,2]

1- Institute of Solid State Physics, University of Latvia, Kengaraga 8, Riga, Latvia
2- University of Latvia, Faculty of Chemistry, Jelgavas 1, Riga, Latvia

Main author email address: Guntars.Vaivars@cfi.lu.lv

Electroreduction of CO_2 represents a promising solution toward addressing global challenges in energy and sustainability [1-3]. The technology success depends on developing efficient electrocatalysts capable of selectively reducing CO_2 to valuable hydrocarbon products at low overpotentials (ethylene, methanol, CO etc.). So far, the best candidate is nanostructured copper and for efficient catalyst reaction, the CO_2 should adsorb from gaseous phase on the catalyst surface. CO_2 capture with ionic liquids is well known. The distinct properties of ionic liquids such as negligible vapor pressure and their affinity to capture the CO_2 molecules make them a feasible alternative for currently available solvents including, different amines. [4]. In this work, we investigated the adsorption process stimulated by ionic liquid. CO_2 adsorption on Cu surface was studied by ATR-FTIR spectroscopy and electrochemical processes by voltammetry.
Spectra measured using FTIR spectrometer Vertex 80v (Bruker, Germany) together with ATR accessory: VeeMAX III (PIKE Technology Inc., USA). The surface of the ATR crystal from germanium was coated with 20 nm thick copper. This surface was blown by a stream of CO_2. In situ measurements showed a significant increase in the adsorption of CO_2 on the surface of copper in the presence of an ionic liquid.
Electrochemical measurements were performed using Autolab potentiostat/ galvanostat in electrochemical cell with $KHCO_3$ electrolyte (1M and 2.5M) at a room temperature. Three-electrode configuration was applied with a copper on ATR crystal as a working electrode and black platinum as a counter electrode.

The financial support of European Union`s Horizon 2020 Research and Innovation Program project under grant agreement No 768789 is greatly acknowledged.

[1] Zhouyang Yin,G. Tayhas R. Palmore, Shouheng Sun, Electrochemical Reduction of CO_2 Catalyzed by Metal Nanocatalysts, Trends in Chemistry, vol. 1(8), pp. 739-750 (2019).
[2] E.E. Benson, C. P. Kubiak, A. J. Sathrum, J. M. Smieja, Electrocatalytic and homogeneous approaches to conversion of CO_2 to liquid fuels, Chem. Soc. Rev., vol. 38, pp. 89-99 (2009).
[3] H.-R. Jhong, S. Ma, P.J.A.Kenis, Electrochemical conversion of CO_2 to useful chemicals: current status, remaining challenges, and future opportunities, Curr. Opin. Chem. Eng., vol. 2, pp. 191-199 (2013).
[4] M. Aghaie, N. Rezaei, S. Zendehboudi, A systematic review on CO2 capture with ionic liquids: Current status and future prospects, Renewable and Sustainable Energy Reviews, vol. 96, pp. 502-525 (2018).