Amino-functionalize porphyrinic catalysts for electrochemical reduction of carbon dioxide
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Abstract: In this work, preparation and investigation of catalytic activities for electrochemical reduction of carbon dioxide (CO$_2$) of 5, 10, 15, 20-tetra(4-aminophenyl) porphyrin and its polymer were described. Electropolymerization of the amino-functionalized monomer was performed on an indium tin oxide (ITO)-coated glass and carbon paper by cyclic voltammetry in dimethylformamide containing a 0.1 M nBu$_4$NPF$_6$ supporting electrolyte with a Pt plate as a counter electrode and a Ag/AgCl quasi-reference electrode (QRE). The electrochemical reduction was carried out under CO$_2$ atmosphere at potential between 0 mV and –1700 mV vs. Ag/AgCl QRE with a scan rate of 50 mV·s$^{-1}$ by using a glassy carbon and a polymer-coated ITO-glass or carbon paper as working electrodes, respectively. Results showed that the current increase of 9% (at –1645 mV) and up to 73% (at –1521 mV) was observed in a CO$_2$-saturated condition when the target monomer and polymer film were used as the catalyst, respectively. Moreover, due to higher surface area of the carbon paper, the current enhancement of the reduction peak was found to be increased, compared to the case of the ITO-glass substrate. To summarize, the target monomer and its polymer should be able to work as electrocatalysts for the reduction of CO$_2$.

Keywords: Porphyrin; Amino-functionalized porphyrin; Electropolymerization; Carbon dioxide reduction