Electrochemistry and Formation of Cobalt Phthalocyanine/ Ps-b-P4VP Microdomains

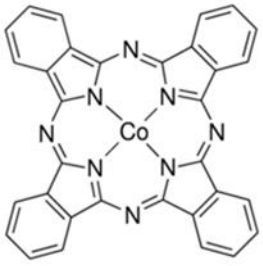
Jared Hague, mentored by Takashi Ito

Kansas state university, chemistry department

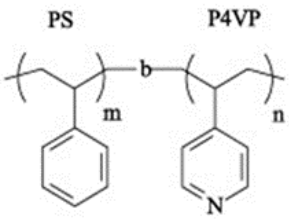
ABSTRACT

Cobalt phthalocyanine is a known electrocatalyst for the reduction of carbon dioxide. Electrodes modified with CoPc show activity for the production of CO. It has also been shown that CoPc can be chemically bound to pyridines, one example being; CoPc/Poly-4-vinylpyrimidine (P_4VP). It was then seen in this example that the potential needed for the reduction reaction to occur had been reduced. In my research we are trying to see if the same principle is true when CoPc is bound to the nitrogen in Ps-b-P4VP. When Ps-b-P4VP is spin coated onto a flat surface it creates a thin membrane made of cylindrical domains. Last semester we found that when Cobalt Phthalocyanine is incorporated into to Ps-b-P4VP, the domains were still able to form. Cobalt is a metal, and is conductive, this is why we hypothesize the new film created will be more electrochemically active.

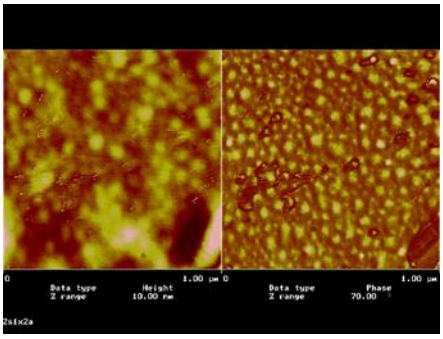
This semester we first needed to make sure the domains would still form on a different type of substrate, or surface, that is conductive. We have seen that they form on glass and this semester we confirmed they also will form on a glassy carbon substrate. The CoPc and Ps-b-P4VP solutions were reacted together in different concentrations to see which concentration of CoPc would lead to the best domain formation. This substrate was needed to preform electrochemical experiments, mainly cyclic voltammetry on the domains we formed on it. We ran into problems with the membrane reacting with dissolved oxygen in our solution and with the solution stripping hydrogen atoms from aromatic rings of the domains. Both these interactions led to false peaks, or results, in our CV readings. We spent a large portion of the semester reducing these interactions by a combination of bubbling the solution with argon gas and by adjusting the range of voltage used in the CV experiments. We were then able to see the peaks from reduction of CO_2. The next step in the project will be to improve the annealing process. This is when the membrane is put under a hot atmosphere of it's solvent, in this case THF. This process lets the domains reform in a tighter formation, which would increase the membrane conductivity. We will also want to see which concentration of CoPc will allow the domains to continue to anneal with the largest amount of CoPc incorporated into the domains. This research is becoming more important as global climate continues to change. Scientists are tying to find efficient ways to remove CO_2 from the atmosphere. CO_2 is a greenhouse gas and also is responsible for the acidification of ocean waters.



CoPc



Ps-b-P4VP



Domain formation