Single Molecule Charging of Redox-Gradient Dendrimers

Grace Chotsuwan, Silas C. Blackstock

MINT Center and Department of Chemistry, The University of Alabama

This project was funded by MRSEC DMR-0213985

Abstract

We have previously demonstrated charging, discharging, and recharging of redox-gradient dendrimer (RGD) thin films on Si/SiO$_2$ by AFM, using Kelvin probe microscopy (KPM) to "read" surface charge domains. In this poster we address two fundamental questions: (1) Do the "written" charges reside in the RGD molecules? and (2) How many charges or charged RGDs are present in a charge domain?

Write, Read, and Rewrite by AFM and KPM

Spin-coated 8CN-4AA/PD on 25 nm SiO$_2$/Si

RGD molecules are selectively charged in a PMMA matrix by tapping AFM at 0.01 V set pt. which controls the degree of "contact" of the tip with the film.

(1) Is the molecule the charge carrier?

To address this question, films of RGDs in PMMA polymer solutions were prepared and subjected to electrified AFM tips.

Mixed PMMA and RGD Film

0.1 wt% PMMA + 0.01 wt % 8CN-4AA/PD in chlorobenzene (10% RGD in PMMA)

Answer: the RGD molecule is the charge carrier.

Spin-coated (4000 rpm/2 min)

Peak Charge Varies with RGD Film Content

Charge conditions: 10V/0s/0.01nm/0.01V set pt.
Tip NSC15 AIBS

Answer: Charge domains in thin neat films involve 10’s of molecules.

Conclusions

• The RGDs can be selectively charged in the PMMA films.
• The dependence of film charging on % RGD content indicates that the RGD molecule is the charge carrier in the mixed films.
• The charging of single RGD molecules in a PMMA film has been observed.
• The effective charging radius of a R$_c$=10 nm tip is ~1.7 nm.
• In neat 3 nm RGD films, charge domains include about 25 RGD molecules.

Center For Materials For Information Technology
An NSF Materials Research Science and Engineering Center

The University of Alabama