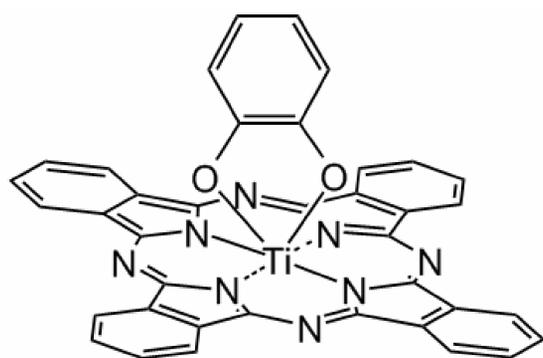


Abstract: Titanium Phthalocyanine with an axially substituted catechol ligand (TiPcat) retains the optical properties that make phthalocyanines attractive as potential light harvesting arrays, optical switches and photonic wires. The addition of the catechol ligand gives the molecule nonlinear optical properties arising from asymmetries in the molecule that create an out of plane dipole moment and an octupole moment. Before we can begin exploiting the nonlinear properties of TiPcat we need to be able to determine its adsorption structure and surface electronic properties. In this study we create a dry monolayer film of TiPcat and image it by scanning tunneling microscopy.

Introduction:

Axially substituting a catechol ligand into Titanium Phthalocyanine (TiPcat) gives the molecule non-linear optical properties. Creating and successfully imaging a dry monolayer that is easy to manipulate is the first step towards exploiting the nonlinear properties. Scanning tunneling microscopy (STM) is an ideal technique for imaging this monolayer because its atomic resolution shows the orientation and layout of the monolayer.

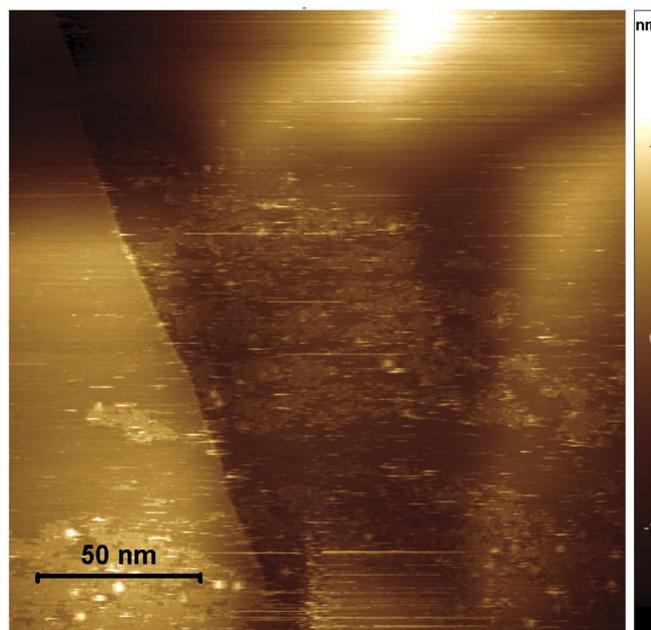


TiPcat molecule¹

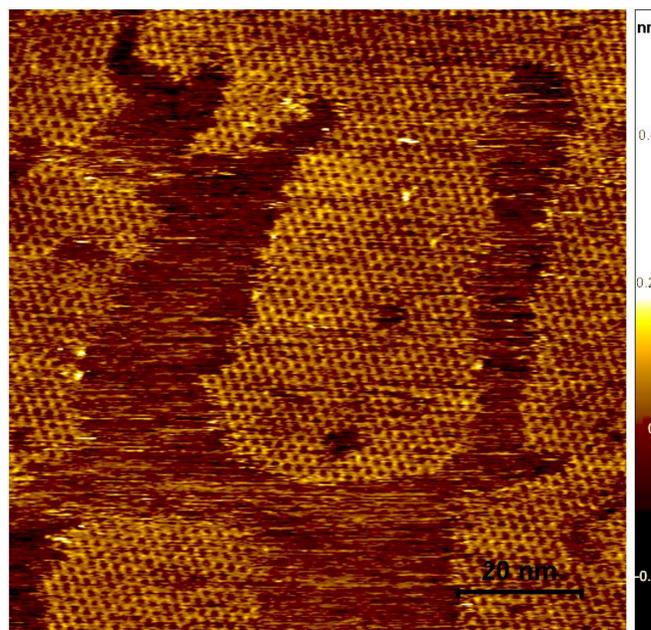
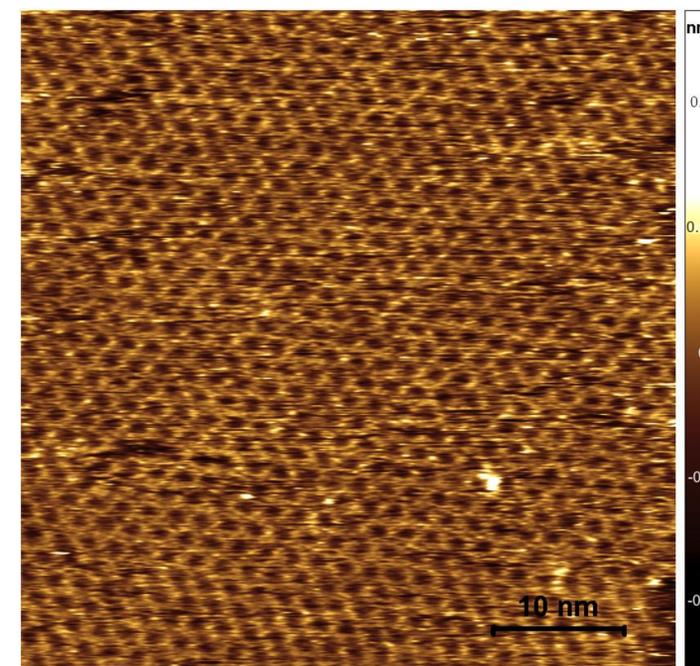
Methods:

To make a monolayer of TiPcat molecules 12 uL of 3 uM were deposited onto the HOPG. The 12 uL took the form of four 3 uL drops. Each drop was deposited on the surface and allowed to deposit for 10 minutes, then the sample was spun out at 4000 RPM. During scanning a small drop of toluene was added and allowed to dry. Set points were 0.8 to 0.9 V and 20 to 25 pA.

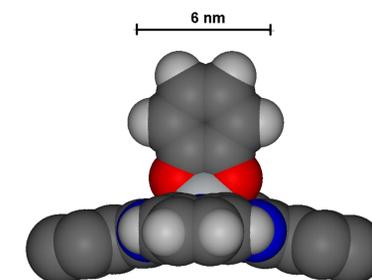
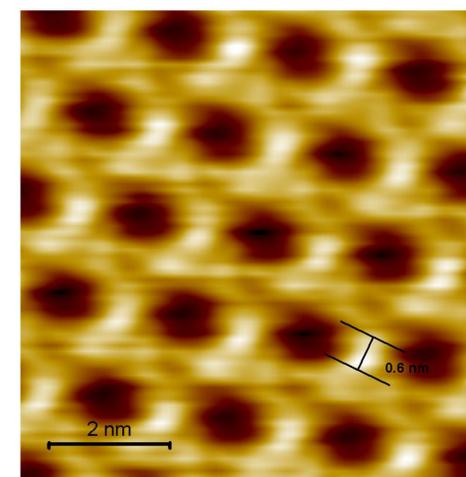
Before the drop of toluene is added the molecules form a diffuse layer.



Higher resolution image after toluene treatment



After the application of toluene you can see the formation of islands of TiPcat



Correlation average image. Unit cell is 1.8 nm by 1.89 nm with a 66 degree internal angle.

Conclusion:

We have achieved and imaged dry monolayers of TiPcat. Scanning through toluene appears to have an organizing effect on the system. The film can be further improved by finding the correct concentration that will allow the formation of a complete monolayer rather than islands. Our ultimate goal is a thorough understanding of the surface supported TiPcat electronic states, as determined by UHV STM and STM based spectroscopy.

Acknowledgements: This work was supported by the National Science Foundation's REU program under grants CHE-0555696 and CHE-0848511

References:

1. Takami, Tomohide; Clark, Aurora; Caldwell, Richard; Mazur, Ursula; Hipps, K.W. *Langmuir*. DOI:10.1021/la1020127

How Does STM Work?

Scanning Tunneling Microscopy (STM) is a form of Scanning Probe Microscopy (SPM) in which a probe is run across a sample to determine the characteristics of the sample. In the case of STM a bias is applied between the surface and the probe. Electrons tunnel from the tip to the surface through an insulator (in this case air). The tip then runs across the surface maintaining a constant tunneling current creating a map of both the topography and the electrical properties of the surface.

