Non-destructive testing to track Cyclododecane Crystallization and the Effects of Crystal Formation on Fragile Porous Substrates

Nicole Peters, Aaron Shugar, Lucy Skinner, Rebecca Ploeger

SUNY - Buffalo State Art Conservation Department

INTRODUCTION

Archaeological excavated artifacts are commonly coated in cyclododecane (CDD) as a consolidant. When CDD coated artifacts are wrapped in airtight enclosures, sublimation is delayed and granular crystals form to replace the initial wax-like film.

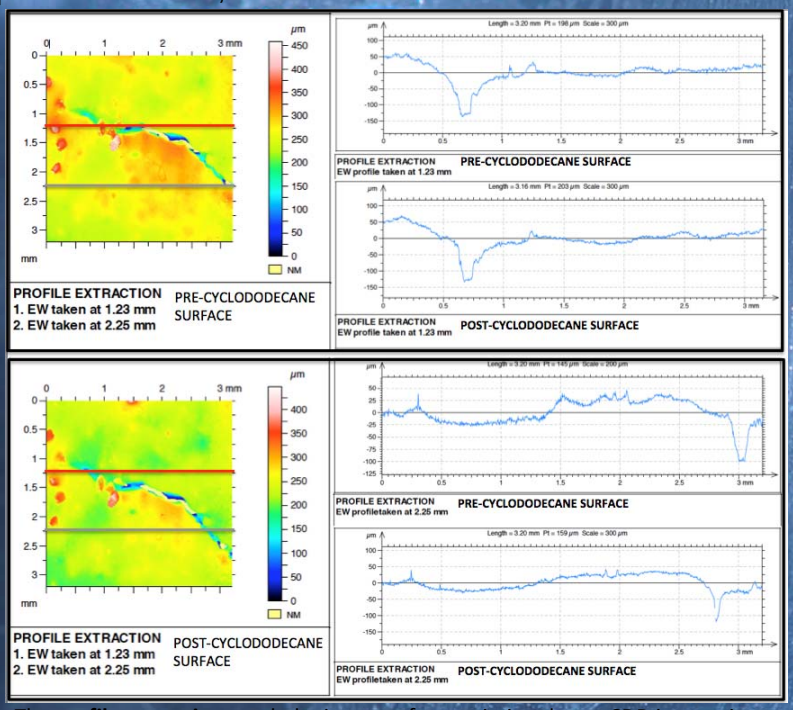
In environments with high fluctuations in temperature, the encapsulated CDD can re-melt and re-solidfy repeatedly. Concern has been expressed that the growth, fluctuating size, and re-deposition of CDD crystals on and within a fragile porous substrate may exert pressure within pores and cracks, causing micro-damage to the artifact that it is meant to be supporting.

Painted plaster mockups were coated with molten and solvent-dispersed CDD and heat-sealed in ESCAL envelopes. The Mockups were then cycled through an ageing regime to simulate high fluctuations in temperature.

CDD crystal formation on plaster mockups

CONFOCAL MICROSCOPY

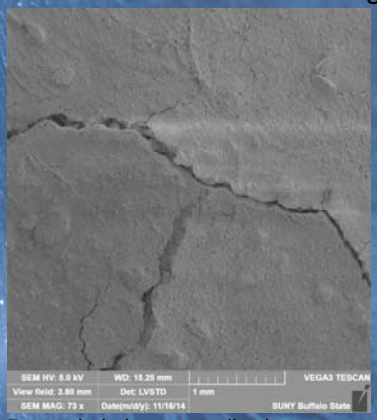
Three computations were used to analyze the topographic deviations caused by CDD interaction; surface subtraction, profile extraction, and horizontal contour extraction.



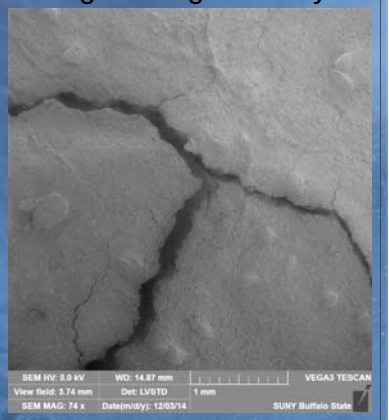
The **profile extraction** reveled minute surface variation due to CDD interaction.

SCANNING ELECTRON MICROSCOPY

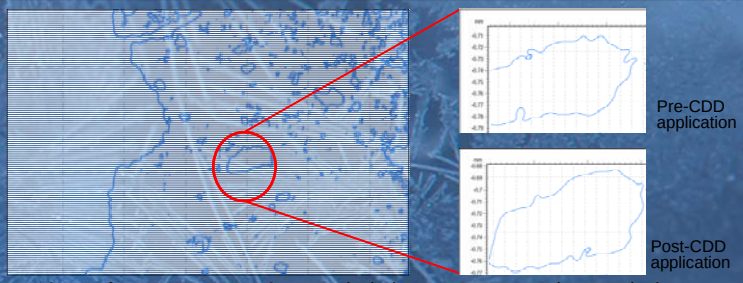
SEM imaging revealed CDD crystal formation extended cracks and caused cleavage/lifting of the ground layer.



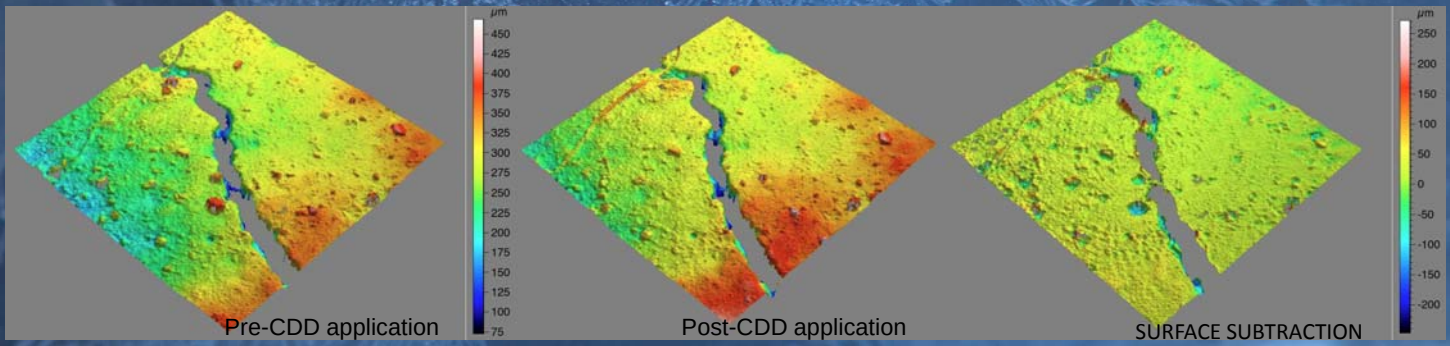
Pre-cyclododecane application



Post-cyclododecane application



Horizontal contour extraction reveled alteration in particle morphology.



Surface subtraction indicates an average change in surface topography totaling 10-20 *u*m.

CONCLUSIONS

Cyclododecane may be altering the original surface of the samples by widening pre-existing cracks, altering particle morphology, and inducing minor elevation changes in the overall topography, but interestingly, it is not imparting a new texture to the plaster nor does it appear to cause new or original cracks in the substrate.

To download our poster scan here:

ACKNOWLEDGMENTS: *The authors would like to thank Patrick Ravines for guidance with confocal microscopy and the Andrew W. Mellon Foundation, Gerald and Sandra Lippes, and Buffalo State College for financial support.*