DOI: 1234567890
Published: 24 July 2018

POSTER ABSTRACT

Microscopic observations to track the behaviour of cyclododecane crystallisation and the effect of crystal formation on fragile porous substrates

Nicole Peters, Aaron Shugar, Lucy Skinner, Rebecca Ploeger and Patrick Ravines

Cyclododecane (CDD) is commonly used in the field of conservation as a temporary consolidant for fragile materials and painted surfaces. Applied as either a hot melt or dissolved in solvent, the volatile binder will solidify, forming elongated crystals; the crystal size depends on the time the CDD takes to set, the application method(s) employed and the atmospheric conditions at the location of application. Normally, CDD will sublime from surfaces of an artefact within a matter of weeks or months (depending on its thickness and local environmental conditions), but if wrapped in airtight packaging, it will remain more or less intact on the artefact. However, it has been observed that over time the CDD crystals appear more granular in shape, while the film becomes less wax-like in appearance. It also appears that the CDD crystals are mobile, and once sublimed they can re-deposit on surrounding packaging materials within airtight enclosures.

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 artefact that it is meant to be supporting.

The objective of this project is to observe the formation and changing structure of CDD crystals and their effect on painted porous surfaces. To investigate the interaction of CDD with absorbent and weak substrates, mock-ups of fragile painted plaster were prepared using coarse quartz sand, gypsum powder and calcium carbonate, loosely bound with animal glue on wooden supports. Pigment loosely bound in gum arabic was painted onto the surface of the plaster. CDD was applied to each of the mock-ups as either a hot melt or dissolved in Stoddard solvent. Sublimation of the CDD was controlled by placing the mock-ups within polyethylene enclosures in order to restrict air movement around them. The temperature within the enclosure was fluctuated in order to encourage sublimation and re-deposition of crystals. Time-lapse microphotography recorded the behaviour of the CDD crystals regularly over a span of six weeks. Scanning electron microscopy and confocal microscopy were utilised before application and after sublimation of CDD to characterise the surface morphology and porosity of the substrate, and to observe any damage that the CDD crystals may have caused to the surface of the artefact.

Three computations were used in conjuction with confocal microscopy in order to analyse the topographic deviations caused by CDD interaction: surface subtraction, profile extraction, and horizontal contour extraction. Surface subtraction indicated an average change in surface topography totalling 10–20 µm. Profile extraction revealed minute surface variation due to CDD interaction, and horizontal contour extraction revealed alteration in particle morphology. SEM imaging revealed that CDD crystal formation extended cracks and caused cleavage or lifting of the ground layer.

It was concluded that CDD 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. However, it does not impart a new texture to the plaster nor does it appear to cause new or original cracks in the substrate.

Biographies

Nicole Peters received a Master of Arts and Certificate of Advanced Study in Art Conservation with a focus in objects conservation from Buffalo State College in 2016. She has completed conservation projects at the Indianapolis Museum of Art, the Eiteljorg Museum of American Indians and Western Art, the Smithsonian Institution's National Museum of the American Indian in Washington, DC, the Arizona State museum, the Doris Duke Center for Islamic Art in Honolulu, HI, the Anchorage Museum in Anchorage, AK, and at the Amarna archaeological site in Tell el-Amarna, Egypt. Nicole has also worked extensively with the National Park Service in southeastern Alaska on the conservation of cultural and historical artefacts and artworks. She operates a private conservation practice based out of Skagway, Alaska, where she continues preservation work with collections containing cultural, archaeological and historical objects and artefacts.

Email: npacsllc@gmail.com

Aaron Shugar is the Conservation Scientist at the Buffalo State College Art Conservation programme. Dr Shugar has a focus on inorganic chemistry and has done work at the Smithsonian Museum Conservation Institute, where he was a Research Associate. He also served as Co-Director of the Archaeometallurgical Laboratory at Lehigh University in Bethlehem, PA. With a PhD in archaeometallurgy from University College London, Dr Shugar has completed extensive research of archaeological metals and glass. Dr Shugar is a Guest Scientist at the National Institute for Standards and Technology (NIST) and a member of the Graduate Faculty at the University of Toronto, and has served as the President of The Society for Archaeological Sciences.

Lucy Skinner is an archaeological conservator specialising in organic materials, particularly from ancient Egyptian and Nubian origins. She is currently enrolled in a PhD programme at the Institute of Creative Leather Technology at University of Northampton and the Departments of Scientific Research and Ancient Egypt and Sudan at the British Museum. The PhD is focused on ancient Egyptian and Nubian leather technology. She is a graduate of the Conservation Department at the Institute of Archaeology, University College London, where she earned an MA and MSc in Conservation for Museums and Archaeology in 2004.

Rebecca Ploeger is the Assistant Professor in Conservation Science at Buffalo State College. Dr Ploeger was a Charles E. Culpeper Advanced Training in Conservation Science fellow at the National Gallery of Art, Washington, DC, in the Scientific Research Department, and collaborated as a guest researcher with the National Institute of Standards and Technology (NIST), Gaithersburg, MD. Rebecca has a Masters degree in Engineering Chemistry from Queen's University, Canada, and a PhD in Chemical Sciences from the University of Turin, Italy, both specialising in polymer materials in cultural heritage. She was also a Lagrange Project post-doctoral fellowship recipient for the study of complex systems from the ISI Foundation (Regione Piemonte).

Patrick Ravines is the director of Buffalo State College's Patricia H. and Richard E. Garman Art Conservation Department. Before joining Buffalo State, he served as senior project conservator and research fellow at the George Eastman House International Museum of Photography and Film, now George Eastman Museum in Rochester, New York. He was an Andrew W. Mellon Fellow in the Advanced Residency Program in Photograph Conservation (2005–2007) at the Eastman House, and, for more than a decade, chief of the Conservation Office, Bahá'í World Centre, Haifa, Israel. He holds advanced degrees in chemistry, library and archives conservation, and library science. Some of his research interests are in surface metrology applied to conservation, 19th-century photographic systems and their material science, and natural water soluble polymers.