# Unruly objects: NFTs, blockchain technologies and bio-conservation

Anna Dumitriu

University of Hertfordshire

Anna Dumitriu is a British artist who works with BioArt, sculpture, installation and digital media to explore our relationship to infectious diseases, synthetic biology and robotics. She has an extensive international exhibition profile including ZKM, Ars Electronica, BOZAR, The Picasso Museum, The V & A Museum Philadelphia Science Center, The Museum of Contemporary Art Taipei and The Museum of the History of Science in Oxford. She was the 2018 president of the science and the arts section of the British Science Association. Her work is held in several major public collections, including the Science Museum London and Eden Project. Dumitriu is a renowned speaker and has presented talks on her work at prestigious venues including TATE Modern, Princeton University, Imperial College London, The University of Oxford, La Musée de la Chasse et de la Nature and UCLA.

Contact: University of Hertfordshire, Hatfield, Hertfordshire, AL10 9AB, UK.

E-mail: contact@annadumitriu.co.uk

Web address: https://www.annadumitriu.co.uk/

https://orcid.org/0000-0001-7219-3954

Alex May

University of Hertfordshire

Alex May is a British artist whose practice forges links between art, science and technology through a wide range of digital new media, including virtual reality, photogrammetry, algorithmic photography, robotic artworks, video projection mapping, interactive installations, generative works, performance, and video and sound art. Alex has exhibited internationally including at the Francis Crick Institute, Eden Project, Tate Modern, Ars Electronica, LABoral, the Museum of Contemporary Art Caracas, the Science Gallery Dublin, University of Calgary (international visiting artist 2016), Texas A&M University and the Beall Center for Art + Technology. He is a visiting research fellow: artist in residence with the School of Computer Science of University of Hertfordshire.

Contact: University of Hertfordshire, Hatfield, Hertfordshire, AL10 9AB, UK.

E-mail: alex@alexmayarts.co.uk

Web address: https://www.alexmayarts.co.uk

https://orcid.org/0000-0003-4927-9615

Athanasios Velios

University of the Arts London

Dr Athanasios (Thanasis) Velios (FIIC) is reader in documentation at the University of the Arts London. His research focuses on the ontology of conservation documentation. He is co-editor of the ICOM CIDOC-CRM, an international standard for describing

documentation of heritage collections including conservation. He leads the Linked Conservation Data consortium investigating and proposing best practices for sharing and integrating conservation data. He is a member of the CEN/TC 346 committee on conservation of cultural property and working with the WG 11 on documentation standards. He is the founder of the Documentation Network of the Institute of Conservation in the United Kingdom and he contributes to the Conservation Data community platform of the International Institute for Conservation where he was webmaster for nearly a decade.

Contact: Ligatus, Chelsea College of Arts, University of the Arts London, 16 John Islip Street, London, SW1P 4JU, UK.

E-mail: a.velios@arts.ac.uk

Web address: https://www.arts.ac.uk/research/ual-staff-researchers/athanasios-velios

https://orcid.org/0000-0002-4654-8675

Zoi Sakki

University of West Attica

Zoi (Zoe) Sakki is a conservator–restorer professional and researcher focusing on biological materials. Her current research interests are positioned in conservation of contemporary art and the ethics based on artworks' vulnerability. She collaborates with Gagosian Gallery Athens and private collectors as a conservator and a restoration consultant (2020–present) and she has been a researcher at the Museum of Criminology at the Medical School, University of Athens (2008–present). She was a research fellow at the Department of Administration, Economy and Communication of Cultural and Tourist Units (School of Management and Economics), Technological Educational Institution of

Central Greece (2017–18) and the Department of Museology-Museography and Exhibition Design, Technological Educational Institution of Patras (2010–11).

Contact: Department of Conservation of Antiquities and Works of Art, School of Applied Arts & Culture, University of West Attica, Egaleo Park, Agioy Spyridonos, 12243, Athens, Greece.

E-mail: zsakki@gmail.com

Web address: https://independent.academia.edu/ZoeSakki

https://orcid.org/0000-0002-8857-9189

Veroniki Korakidou

Hellenic Open University and University of Thessaly

Veroniki Korakidou is an art theorist and artistic researcher. Her research focuses on the philosophical aesthetics of media and post-media art, ranging from film to interactive art, as well as the intersections of art and the life sciences, including both hybrid bio-digital art practices and environmental artforms related to natural ecosystems. She is an adjunct professor at the Hellenic Open University, School of Applied Arts (2016–present), a research fellow at the University of Thessaly, Department of Culture, Creative Media and Creative Industries (2020–present) and was a visiting lecturer at the Department of Graphic Design and Visual Communication, University of West Attica (2014–16). She is author and co-author of several scientific publications in international peer-reviewed Journals including *Technoetic Arts*, *Intellect and Leonardo Journal* and MIT Press.

Contact: Hellenic Open University, George 4, Canning Square, 10677, Athens, Greece and Department of Culture, Creative Media and Industries, University of Thessaly, 37, Glavani str. & 28th October, 38221, Volos, Greece.

E-mail: korakidou.veroniki@ac.eap.gr

Web address: https://eap.academia.edu/VeronikiKorakidou

https://orcid.org/0000-0001-5038-5138

Hélia Marçal

University College London and Universidade Nova de Lisboa

Hélia Marçal is lecturer in history of art, materials and technology at the Department of History of Art, University College London (2020–present), a researcher at the Institute of Contemporary History, Nova University Lisbon (2021–present) and the coordinator of the working group on theory, history and ethics of conservation of the Committee for Conservation of the International Council of Museums (ICOM-CC) (2016–present). She was the fellow in contemporary art conservation and research of the research project 'Reshaping the collectible: When artworks live in the museum, at Tate, London' (2018–20). Her current research interests are positioned within feminist new materialisms, material histories of activist artworks, ethics and performativity of cultural heritage, the conservation of time-based art and both the materiality of contemporary art and the ways it is positioned and negotiated by museum, heritage and conservation practices.

Contact: Department of History of Art, G03, University College London, 20 Gordon Square, London WC1H 0AT, UK and Instituto de História Contemporânea, Universidade Nova de Lisboa, Lisboa, Av. Berna, 26 C 1069-061, Portugal,

E-mail: h.marcal@ucl.ac.uk

Web address: https://www.ucl.ac.uk/art-history/dr-helia-marcal

https://orcid.org/0000-0002-0476-5233

Georgios Panagiaris

University of West Attica

Georgios (George) Panagiaris is a biologist (biological sciences) and he is licensed by the Hellenic Ministry of Culture as Conservator of Organic Materials. He is professor and president at the Department of Conservation of Antiquities and Works of Art, University of West Attica, GR (UniWA). He has been director (2015–18) at the interinstitutional postgraduate course entitled 'Museum studies', co-organized by the University of Athens and UniWA and member of its administration board (2003–present). He is an official national expert and voting member in CEN/TC346 working at European level to standardize the work of the Cultural Heritage Preservation. He is a member of the ICOM Conservation Committee with active participation in working groups dealing with collections of natural history and ethics issues. His scientific/research activity focuses on issues of conservation of organic materials with emphasis on forensic science specimens, human remains and collections of natural history, issues of biodeterioration in museum collections and on ethical management of these. He has participated as principal author in numerous collective publications, original papers in scientific journals and in international or Greek conferences. He has coordinated many research programmes and he is reviewer in Elsevier and Taylor & Francis editions.

Contact: Department of Conservation of Antiquities and Works of Art, School of Applied Arts & Culture, University of West Attica, Egaleo Park, Agioy Spyridonos, 12243, Athens, Greece.

E-mail: gpanag@uniwa.gr

Web address: https://cons.uniwa.gr/en/profile/georgios-panagiaris/

https://orcid.org/0000-0003-3789-3183

Received 25 October 2021; Accepted 4 May 2022

## Abstract

This article explores and challenges notions and methodologies of conservation, including the use of blockchain technologies as a means of establishing provenance of a physical BioArtwork, of the artist's documentation encapsulating their intentions and of the conservator's records required for the artwork's ongoing care. The exploration is done through a case study of an art project called 'Unruly Objects and Biological Conservation' created by Anna Dumitriu with support from Alex May. The artwork consists of three items containing RFID tags sealed in resin – which point to the location of the artist's documentation. Therefore, the works physically include instructions for maintaining their inherent concepts and materiality for the benefit of the conservators. Such instructions can often be difficult to track down, or become disassociated from the artwork while the digital preservation of this storage method also poses its own set of questions. The works also include biological material including mud from a bacterial ecosystem known as a Winogradsky Column, living plant material and SARS-CoV-2 (coronavirus) RNA from a plasmid construct.

Keywords: bio-digital art, bio-digital conservation, museum documentation, BioArt, bacterial sublime, mineral agency

## Introduction

Lead artist Anna Dumitriu works with both physical and digital media and involves both living and non-living matter in her work. According to Byung-Chul Han in Undinge (Nonobjects): '[t]he digital order deobjectifies the world by rendering it information'

(Borcherdt 2021, n.pag.). Over the last decade, however, there has been a renewed interest in objects, 'a shift from the human experience of things to things themselves' since 'agency always emerges as the effect of ad hoc configurations of human and nonhuman forces' (Bennett 2010, n.pag.).

Recently, Dumitriu has been exploring the biology and chemistry of conservation through a case-study of an art project called 'Unruly Objects and Biological Conservation' created by the artist herself with support from Alex May and in collaboration with Professor Georgios Panagiaris, head of the Department of Conservation of Antiquities and Works of Art at The University of West Attica in Athens (Greece) and a team of researchers. In his lab Professor Panagiaris' team explores the biochemistry of bacteria and yeasts to produce microbes that are able to aid in the preservation of artworks and antiquities rather than causing damage to them. This concept is expected to reveal specific microbiomes and yeasts which would provide an environment appropriate for stabilizing artworks' decay.

Dumitriu is collaborating with this research team to explore the ethics and risks of such a strategy and discuss how these ideas will impact the preservation of contemporary 'unruly objects' (Dominguez Rubio 2014). In characterising museum objects, the sociologist Dominguez Rubio suggests two classes of objects: docile and unruly. Docile objects, in this analysis, are objects – such as oil paintings – that adapt to museum structures or, in other words, for which the museum was created. Unruly objects – such as BioArtworks (involving living materials as bacteria and yeasts) – are objects that resist the (infra)structures of the museum, unfolding over time, usually in unpredictable and risky directions. Although the conservation of objects that can be considered 'unruly',

such as performance art, time-based media or installations, has been explored through diverse angles (e.g. Marçal 2022; Castriota 2021; Scholte 2022), the conservation of BioArt is still understudied and has been rarely discussed within the field of conservation. In this project, an interdisciplinary team guided by lead artist Dumitriu expands on this notion of unruliness, engaging in various research fields. The lead artist makes her own artistic experiments inspired by the lab's research and kick-starting discussions around the preservation of contemporary BioArt in the context of a major institution.

Through discussions in this project, the lead artist learned that a key element in conservation is to preserve the story of the object. It seems that Dumitriu's alterations of historical artefacts in works such as 'Pneumothorax Machine' or 'Blue Henry' are in line with this, as they help the objects communicate their relevance and meaning. In a way Dumitriu's work can be seen as a form of meta-conservation. In fact, the three 'sketches' that Dumitriu has so far made for this project reveal the processes and challenges of conservation and can perhaps be seen as conserving conservation.

## Object vs. data: Materiality, information and structural similarities with living organisms

The 'Unruly Objects' project explores crypto-technologies and what benefits these may provide for our ability to understand the present-day intentions of artists in the future. This is done through an interrogation of conservation processes. The project, therefore, explores the ways in which crypto-technologies are (or can be) entangled with the perpetuation of cultural objects and their plural materialities.

Although the so-called CryptoArt usually has a purely digital form, the lead artist uses blockchain technology, because – among other things – it also makes it possible to maintain a distributed digital ledger, the validity of which is agreed upon by multiple people. This ledger can be used to confirm the authenticity of items including material things, objects, artefacts and digital records, without any other means or proof of trust. This allows records of the artist's intentions, ideas and the complexity of her multi-layered works to be stored, perhaps for many generations in the future.

NFT is a token that points to either a material or digital thing such as an artwork – it is not the artwork. The token does not have its own identity, it functions as an identifier that points towards the artwork. NFT artworks comprise digital image files that can sometimes be traded for high-prices and they enable the existence of a market for digital image files. However, this artistic action is not concerned with the financial side of NFTs; instead, it is interested in this technology because of its nature as a robust identification system. In this sense, the project goes beyond simply minting an NFT for the purpose of selling a digital artwork. The field where this project wishes to explore the use of NFTs is art conservation, digital documentation and 'smart contracts'. The questions the lead artist poses are: What can this technology be used for? What problems can it solve? How does it work? What methodologies should we use to conserve art? How can this technology be used to provide certified provenance for the artwork, the artist's documentation and the conservators' documentation updates? The description of the object, alongside relevant documentation, can be stored using this technology for future conservators, in order to guarantee its authenticity credentials.

The sketches also include biological material including mud from a bacterial ecosystem known as a Winogradsky Column, Common Cress seeds and SARS-CoV-2 RNA (coronavirus) from a plasmid construct. This last element is a safe, non-infectious reagent for SARS-CoV-2 research (NIBSC 19/304), obtained from the National Institute for Biological Standards and Control, United Kingdom. SARS-CoV-2 RNA was supplied by researchers Dr Inêes Moura and Dr Jane Freeman at the University of Leeds who are working with the SARS-CoV-2 primers and the RNA construct in the development and use of a RT-PCR assay for SARS-CoV-2 detection in faeces. The SARS-CoV-2 RNA is used as a kind of timestamp to indicate the year the artwork was made, during the COVID-19 pandemic. It is a reference to the procedure of looking at RNA/DNA for determining the provenance of an artwork. Our speculative understanding is that this substance is something that future conservators could be able to find a supply of and apply to the artwork again as part of a potential conservation treatment. Although a token is not a material object, there is a relationship between NFTs/coding and bacteria/living organisms, not only in the sense that DNA stores information, which is the most common metaphor, but rather in the sense that blockchain technologies are a distributed network, which works with nodes, in the same way that bacterial communication systems also work. There are similarities between ‘Cybernetic Bacteria 2.0’ and ‘Communicating Bacteria’. It is all about networks, there is definitely an echo there between this and all other Dumitriu works, including ‘Make Do and Mend’ (Dumitriu and Neely 2021).

## Unruliness, agency and the sublime

Furthermore, there seems to be a relationship between NFTs, bacteria and the sublime. One might say that Lyotard’s ideas (1991) about a network of interconnected cables and

screens can be linked to blockchain technology. The blockchain consists of distributed nodes – it is the ledger; blockchain technologies work to approve the next block in the blockchain.

In this artwork there are both living and non-living materials used as materials. Artwork's materials include physical minerals (marble), human-made components (paint, RFID card), bacteria (Winogradsky Column) and plants (common cress). There are also other biological materials, such as RNA from a plasmid construct, which is of biological origin and which however is not considered alive. This particular instance of RNA contains information and it can be damaged by UV light, easily becoming fragmented. Its invisibility (at least to the naked eye) raises other concerns: its absence would likely not be missed to a member of the public, and yet, the lacuna it would produce could potentially impact the identity of the artwork – or its presence in the realm of the sublime. Indeed, according to the seventeenth-century political scientist Edmond Burke, the sublime is 'that moment when all the motions of the senses are suspended with some degrees of terror' (1757, 55). For him obscurity is important for the sublime, something hard to see 'even the littlest of things'. Artist's documentation can, on the other hand, here serve as a dual role – one of producing traces of a process of making alongside other of perpetuating the memory of the virus when it is no longer an intrinsic part of the artwork. Is SARS-CoV-2 RNA an unruly entity, part of an unruly object? Must we preserve this particular instance of the RNA for the future generations? If so, why?

Can we consider part of the above materials as agency upon the artwork? In order to see if bacteria and plants have agency upon the artwork, we first need to define agency. According to the philosopher Monika Bakke (Wöhrer 2019) minerals have

agency, which turns the notion of agency as science on its head. Indeed, the agency of nonhumans has been a topic of relevant scholarship in science and technology studies and philosophy (among other fields) for quite some time: from Donna Haraway's *Cyborg Manifesto* (1985), to more recent explorations by authors like Bruno Latour, Karen Barad or Jane Bennett, just to name a few. Karen Barad, particularly, developed a theory of *agential realism* to map out the relational nature of intra-relations and actions among humans and nonhumans (Barad 2007). These approaches resonate with the work of Anna Dumitriu, where the agency of minerals, water and air molecules, the molecules that make up viruses and bacteria, all relate in processes of intra-agencial making. According to the lead artist, DNA is essentially a mixture of minerals (molecules) with the ability to make protein, as referenced in her work 'The Chemistry of Biology' (Dumitriu and Neely 2021), and they certainly can lead to agency. Agency and consciousness are linked, but the lead artist believes that consciousness is an emergent property, a sensation that arises when a large number of neurons connect and interact with an environment (Seth 2021). The question remains, whether there is a creative part on behalf of the living organisms that is set within the intentions of the artist (i.e. unpredictability, chaotic behaviour or the bacterial 'sublime').

According to Dumitriu, these bacteria and plants will affect the object. This is very well set within the artistic intention, which alludes to abstract expressionism or modernism where the hand of the artist is being 'removed'. Abstract expressionism is linked with the physicality of artistic gesture and the body – the idea of removing the artist's hand in various ways. The bacteria on the artwork are sending quorum sensing signals in the form of hormones which can communicate with other nearby bacteria. So,

there is a form of communication and they can make collective decisions or choices which makes them autonomous. At certain stages, some living organisms can turn into a dormant state – they become spores and can stay like that for years by creating a shell around themselves. A living organism can change between being alive and this state, e.g., sporulating bacteria can be reactivated when water and nutrients become available again.

Dumitriu is embracing the fact that these environmental 'tools' are creating textures, like paint. Paint is made from minerals and is not static. It, too, changes with different light conditions. An example that was an inspiration for the artist while developing this project was ancient paints, thus bringing forth questions of both conservation and alteration of a work of art through time and environmental conditions. In this work, modern artists' acrylics were used but with the colours of antiquity. In addition, the use of bacteria as 'living paint' makes the issue of conservation more complex and pushes the notion of unruliness. They are autonomous and can destroy or complete the object. They have unique ways of forming patterns and are semi-predictable. They do have autonomy, however, the artist can use them to create predictable patterns that are interesting – for instance, some bacteria make petal-like shapes when grown in the presence of two different antibiotics.

Although these patterns are only semi-predictable, there is still a lot of control on behalf of the artist. Here is where the similarity between bacteria and living organisms is set, when used as materials for creating art and the similarity with paint as used in abstract expressionism and conservation. Paint also reacts in different ways within time and when exposed to the external environment. It takes a form of its own, similar to

organic interactions. These techniques of painting are unstable as well, and they can start to decay if the surface is not prepared properly.

## Work in progress: The 'fates' of the three objects

Dumitriu during her residency at the University of West Attica has power-carved and painted a series of three marble sculptures (Figures 1 and 2), which she describes as sketches, inspired by scanning electron microscope (SEM) images of the microorganisms that eat away at antiquities and images of the damaged stone (the SEM images were created by Athanasios Karabotsos). The intricate holes in the work were carved after conservator Zoi Sakki told the lead artist that bacteria and plant roots are one of the greatest challenges to her work in preserving ancient Greek antiquities. The painting on the marble surface references how ancient Greek statues were originally brightly painted and looked nothing like our modern notion of classical art. When the colour (or some other aspect) disappears from a modern artwork, that part of the work is usually hidden from view (retired to the archive).

The three sketches have been split up and experience different fates: the first will remain with the artist who will observe its changes and try to capture and preserve its decay at the most beautiful point. This is inspired by a visit to The Eastern State Penitentiary Museum, a former prison in Philadelphia, where the curators are attempting to maintain it in a state of partial but beautiful decay. A second sketch has been buried in a Winogradsky Column where the bacteria there will interact with it (the result cannot be fully anticipated), and the third sketch has been sent to the University of West Attica where Athanasios Karabotsos will look at it under his scanning electron microscope and conservator Zoi Sakki will undertake conservation work. Also working with Zoi Sakki on

conservation documentation are Athanasios Velios and Alex May. The documentation and provenance of the works will be stored on the blockchain and more details about this process will be shared publicly when it has been completed. Part of this involves collating and storing the artist's documentation records and subsequent conservation reports.

**Figures 1 and 2:** The three marble sculptures, power-carved and painted by lead artist Anna Dumitriu.

The Winogradsky column is a whole self-sustaining ecosystem in a jar. It contains a lot of different species of bacteria that help balance and sustain each other. It will eventually alter the ecosystem into what these organisms need to survive in. Doing so, the organisms apply their own survival strategy on the artwork and thus, the artwork becomes 'food' for the ecosystem. What would be the ideal sculpture for bacteria? This is a question for the lead artist to dwell upon. Do they really need the artwork in order to survive? The answer is no, the created environment is enough to keep them alive; they rather eat off the artwork in order to thrive, which plays with the notion of definition of art itself. Furthermore, it raises questions regarding biological balance and maintenance of ecosystems. The RFID card will also be eventually consumed by bacteria, due to the fact that it is made of copper. Half of it is buried in the mud. The whole Winogradsky Column is mud. Contemporary RFIDs may look like the Antikythera mechanism to future archaeologists, an artefact which has also been a fascinating inspiration upon which the lead artist has drawn. In the future, this technology might be interpreted as an 'ancient' or 'obsolete' technology, and it is unclear whether it will be readable by future generations. In this sense, the technology, too, is also decaying.

## Process of bio-digital conservation: Conceptual conservation

The project also explores and challenges notions and methodologies of conservation, including the use of blockchain technologies as a means of storage for the provenance of the artwork, of the artist's authentic documentation and of the artist's intentions. Within the project's concept is fundamental to explore challenging notions and methodologies of BioArtworks' conservation, as well as the process of preservation of the entire artwork: identity, materials and data. Traditional preservation efforts applied to the materiality of a contemporary artwork that includes biological materials (image, form and shape) are inadequate as the artwork's identity might disappear or change with the alteration or loss of its original materials. The meaning of the work – as well as its significance – will also inevitably change with the evolving sociomaterial conditions of the contexts in which it is displayed. Crucially, changes in meaning and significance sometimes pose dilemmas that can be more complex than the ones caused by either material alteration or the need to keep those same materials static. At their core, these are the discussions that, oftentimes, are prompted by these so-called 'unruly artworks', and for which a straightforward solution is far from sight. BioArtworks pose additional challenges, as their very nature usually prevents them to be included in museum collections, which typically have health and safety requirements and environmental regulations that are not in tune with the (intentional) survival of microorganisms, as one sees with works by Dumitriu. Due to the use and development of digital formats and electronic artefacts, the works developed by the artists for this project have an additional layer of complexity, which typically demands bespoke conservation strategies and a considerable resource allocation by collecting institutions. Working and thinking with

this artwork, however, allowed us to think about conservation as a practice and on the limits of the ambition to conserve these works in a museum environment.

## Reliability of documentation

Conservation is of vital importance for preserving artworks' integrity. It is a complex assemblage of actions which facilitate the appreciation, understanding and use of artworks, via extending their materiality. From a conservator's point of view, the materiality of the artistic object is the medium, through which the artist 'speaks' to his/her audience. Moreover, reliability of documentation – both artist's documentation and conservators' documentation – is part of the conservation process itself and is critical for ensuring that conservators of the future will have key information to work with. The reliability of documentation in conservation is critical for ensuring that future conservators have relevant information to work with.

As part of this project, the team is exploring ways of ensuring that the documentation produced by the artist and the conservator can be traced back to their original sources to establish their reliability and reflexivity. This means that in the future, conservators can access reliable information about the artwork, including (1) important concepts encapsulated in the artwork as conceived by the artist during production, and (2) important material properties of the artwork as recorded by the conservator.

In addition to reliability, we are considering how such information can be communicated through structured data. This is important for collections of BioArt because the materials and substances used in the artwork need to be flagged for risk assessment. Describing such material using simple text is adequate but it makes such flagging difficult. Structured data makes this task straightforward. A well-defined model

for producing structured data is the Conceptual Reference Model maintained by the International Committee for Documentation of the International Council of Museums (also known as CIDOC-CRM) (Doerr 2003). As part of the project, we are also exploring: (1) whether the CIDOC-CRM is expressive enough to capture the concepts and materials encapsulated in BioArt and (2) how documentation based on the CIDOC-CRM can be made available in a way that provenance can be traced. To reach the latter goal, we are using blockchain technology.

Blockchain technology has been widely used as a means to trace digital currency exchanging hands during transactions. The technology utilizes a distributed ledger of transactions where each transaction is stored and verified. As such, it is possible to trace currency through transactions. In a similar fashion the same technology can be used to discover the provenance of things other than digital currency. The principle is that traceable tokens are issued to represent things. These tokens can then be checked in the public ledger for their origin and validity thus establishing provenance. A token can hold data and, by providing a unique reference to an external document within the token, one can supply extensive descriptions of things associated with the same token. Such a unique reference can typically be a URL or other unique identifier which points to an online resource such as a web-page file. In order to ensure relative stability of the resource that the token points to, the Inter-Planetary File System (IPFS) can be used because it maintains files that cannot be edited once uploaded. Figure 3 shows the current experimental setup being tested.

The physical artwork is therefore represented by a blockchain token. Each set of documentation records is also represented by a token. These records are produced based

on the CIDOC-CRM model and they can be rendered as web-pages. The documentation web-pages are stored in IPFS at the time of production and therefore remain unchanged. The tokens corresponding to the documentation hold a reference to the web-pages in IPFS thus ensuring traceability and stability of the documentation. The tokens also refer to previous tokens as a way of establishing clear references to earlier documentation and the artwork.

The artwork contains an RFID tag sealed in resin. The encoded data in that tag includes a reference to the blockchain token representing the artwork. This ensures that no other token can be claimed to represent the artwork without damaging the artwork (by removing the RFID tag), thus arguably destroying parts of its identity as encapsulated in its materiality.

The documentation produced as structured data and based on the CIDOC-CRM borrows from principles and methods of Linked Data. We are using the Resource Description Framework (RDF) (RDF Working Group 2014) to produce records based on the CIDOC-CRM model. For Linked Data implementations it is necessary to provide identifiers for components that need to be described in the documentation. These identifiers are often used as URLs for delivering descriptions of components within a web browser. In theory these identifiers can be provided by IPFS; however, this is only possible after inserting a file into IPFS and typically these URLs need to be known in advance so that the interlinking required by RDF among statements about components can take place. In order to work around this problem, we are taking advantage of the redirection tools offered by the w3id community (W3id.Org n.d.) for identifiers as follows: while preparing the Linked Data dataset, we produce URIs based on a prefix

(w3id.org/uro/) followed by relative paths. For example, w3id.org/uro/component/1. A set of interlinked web-pages representing the Linked Data records are built as relative paths based on the single prefix. Once the set of files is uploaded to IPFS, an IPFS identifier is created and the w3id.org prefix can be programmed to point to it.

**Figure 3:** The current experimental setup we are testing.

A discussion on the nature of the substances contributing to BioArt artworks has taken place and we can say that the coverage of the CIDOC-CRM model is adequate. Elements like the Winogradsky Column contain living organisms and as such can be classified as CRM E20 Biological Objects. The impact of such material to the rest of the artwork can be described using the CRMsci S18 Alteration class. A discussion around the agency of such materials is still pending in terms of the ontological understanding from an information science point of view.

Albeit the possibilities brought by this technology, there are still questions around the maintenance of these digital objects: if these objects allow for a relationality that is typically hard to produce in current models of Collection Management Systems (CMS), access to data might be complexified with shifting technological ecosystems, and studies are still needed to understand the ways in which the use of NFTs and blockchain can be adapted and sustained by museum technological infrastructures. On the other hand, the museum's growing concern with their impact in a world imploding in the age of the Anthropocene puts into question the potential of carbon-heavy technologies. However, this work will use proof of stake technology, when possible, which will mitigate this issue. At the same time, where does the limit between the biological agents here explored

and the potential for mass extinction promoted by climate change and continuous carbon emissions lie?

## Conclusion: Expected outcomes and future plans

It is the things that have the capacity to survive that can tell the story of an object in the future. Stone usually survives, at least for what could be considered long periods of time and in the current planetary conditions. Will the blockchain survive? Another question is how could NFTs help the conservation of digital arts/computer arts? One could argue that using NFTs is currently in trend, particularly when devising strategies to track and trace the provenance of artworks. This technology was chosen for this project, because it is a safe technology to use, in terms or trust among networks and systems. Similarly, when talking about redundancy, computers, high level of security and materials critiquing, this project is playing with the issues inherent in conservation. The artwork can exist as long as it has a kind of materiality – which is not necessarily constricted to its original materials. While the ambition of eternity is no more than utopia, imagining speculative futures as those of conservation can be helpful in rethinking questions around the artworks and their expected temporality. What does a conservator deal with on an everyday basis? What kind of information do we need to provide, so that a future conservator will need to have access to? Will future conservators/archaeologists be able to access the RFID card and find the documentation records embedded in the artwork? How will they perceive the story of the object within their context? In this case, the original documentation will go to the blockchain and a conservation report will be pointing at the artist's original documentation, providing all relevant information, to create some form of redundancy. In this sense, it all becomes an unbreakable chain in the

artwork's history, provided the files are still hosted. This may be considered as a permanent record as long as this technology still exists and is understandable – which might not happen in the medium- to long-term. Furthermore, the sketches produced by Dumitriu also work as a test on how one could extend the life of an object. The paradox here is important – what is the permanence of things made to be permanent records, and what is that of things we typically think of as fragile, transitory and ephemeral?

Echoing Umberto Eco, one last question that still remains pertains to the openness of this work (Eco et al. 1962). Zoi Sakki is re-growing cress on one of the sketches, another one is in a plastic box and still decaying, the third one is inside a Winogradsky column with bacteria acting on it. These biological materials are parts of the artwork and these, too, are developing their own lifepaths. Moreover, living, semi-living (e.g. the RNA from a plasmid construct is not alive but semi-living) and non-living materials are being used in this artwork, which reframes questions around liveness and the continued conservation of these works. Finally, both the artwork and the research around its preservation and documentation are still in progress. This article is the first iteration in the pursuit of a discussion regarding further protocols created by other researchers in the field.

## Acknowledgements

This article presents initial outputs of the project called 'Unruly Objects and Biological Conservation'. This project is undertaken by the lead artist Anna Dumitriu with support from the artist Alex May and in collaboration with Georgios Panagiaris (University of Western Attica, Department of Conservation of Antiquities and Works of Art) and his colleagues (internal and external) including: Athanasios Karabotsos (UniWA), Dr Zoi

Sakki, Veroniki Korakidou (HOU, UTH), Dr Athanasios Velios (UAL) and Helia Marçal (UCL). Helpful for the project were also lead artist's interviews with professors of the Department of Conservation of Antiquities and Works of Art Ekaterini Malea (UniWA), Maria Chatzidaki (UniWA), Andreas Sabatakos (UniWA), Alexis Stefanis (UniWA), Anastasios Koutsouris (vWA) and Leonidas Karampinis (UniWA). The project received funding from an A-N Artists Bursary 2020 (extended to 2021 due to the COVID-19 pandemic).

Hélia Marçal's work on this paper was supported by UCL and by Fundação para a Ciência e a Tecnologia (FCT), I.P. (project grant 2020.04286.CEECIND). The Institute of Contemporary History is also supported by FCT, I.P. through projects UIDB/04209/2020 and UIDP/04209/2020.

## References

Barad, Karen (2007), *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, Durham, NC and London: Duke University Press.

Bennett, Jane (2010), *Vibrant Matter: A Political Ecology of Things*, 1 ed. Duke University Press. Project MUSE muse.jhu.edu/book/70734. Accessed 21 June 2022.

Borcherdt, Gesine (2021), 'Byung-Chul Han: How objects lost their magic', Art Review, 11 August, https://artreview.com/byung-chul-han-how-objects-lost-their-magic/. Accessed 25 October 2021.

Burke, Edmund (1757), *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*, London: R & J. Dodsley,

https://en.wikipedia.org/wiki/A_Philosophical_Enquiry_into_the_Origin_of_Our_Ideas_of_the_Sublime_and_Beautiful. Accessed 25 October 2021.

Castriota, Brian (2021), 'Object trouble: Constructing and performing artwork identity in the museum', *ArtMatters International Journal for Technical Art History*, Special Issue 1, pp. 12–22, https://www.amjournal.org/special-issue-1. Accessed 2 May 2022.

Doerr, Martin (2003), 'The CIDOC conceptual reference module: An ontological approach to semantic interoperability of metadata', *AI Magazine*, 24:3, pp. 75–92, https://doi.org/10.1609/aimag.v24i3.1720. Accessed 25 October 2021.

Dominguez Rubio, Fernando (2014), 'Preserving the unpreservable: Docile and unruly objects at MoMA', *Theory & Society*, 43:6, pp. 617–45, https://escholarship.org/uc/item/9qr4d9qx. Accessed 25 October 2021.

Dumitriu, Anna and Neely, Robert K. (2021), 'An alchemy of DNA: Exploring the chemistry of biology through bioart', *Leonardo*, 54:2, pp. 210–11, https://direct.mit.edu/leon/article/54/2/210/97204/An-Alchemy-of-DNA-Exploring-the-Chemistry-of. Accessed 25 October 2021.

Eco, Umberto, Cancogni, Annapaola and David, Robey ([1962] 1989), *The Open Work*, Cambridge, MA: Harvard University Press.

Haraway, Donna ([1985] 1991), 'A cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century', in *Simians, Cyborgs, and Women: The Reinvention of Nature*, New York: Routledge, pp. 149–81.

Lyotard, Jean-François (1991), *Leçons sur l'Analytique du Sublime* (*Lessons on the Analytic of the Sublime*), France, Éditions Galilée and Stanford University Press,

https://en.wikipedia.org/wiki/Lessons_on_the_Analytic_of_the_Sublime. Accessed 25 October 2021.

Marçal, Hélia (2022), 'Becoming difference: On the ethics of conserving the in-between', *Studies in Conservation*, 67:1&2, pp. 30–37, https://doi.org/10.1080/00393630.2021.1947074.

RDF Working Group (2014), 'Resource description framework (RDF)', W3C Semantic Web, 25 February, https://www.w3.org/2001/sw/wiki/index.php?title=RDF&oldid=4387. Accessed 25 October 2021.

Scholte, Tatja (2022), *The Perpetuation of Site-Specific Installation Artworks in Museums*, Amsterdam: Amsterdam University Press.

Seth, Anil (2021), *Being You: A New Science of Consciousness*, https://www.penguinrandomhouse.com/books/566315/being-you-by-anil-seth/. Accessed 25 October 2021.

W3id.Org (n.d.), 'Permanent identifiers for the web', W3id.Org, https://w3id.org/. Accessed 14 January 2021.

Wöhrer, Renate (2019), 'Monika Bakke: Mineral companionships of evolving environments', in *Tuning into Worlds: More-than-Human Aesthetics in the Arts*. Lecture series of the DFG Research Training Group 'Knowledge in the Arts' in cooperation with Studium Generale, UdK Berlin, Universität der Künste Berlin, https://www.udk-berlin.de/forschung/temporaere-forschungseinrichtungen/dfg-graduiertenkolleg-das-wissen-der-kuenste/veranstaltungsarchiv-des-dfg-graduiertenkollegs/tuning-into-worlds-more-than-human-aesthetics-in-the-

arts/monika-bakke-mineral-companionships-of-evolving-environments/.

Accessed 25 October 2021.

## SUGGESTED CITATION

Dumitriu, Anna, May, Alex, Velios, Athanasios, Sakki, Zoi, Korakidou, Veroniki, Marçal, Hélia and Panagiaris, Georgios (2022), 'Unruly objects: NFTs, blockchain technologies and bio-conservation', *XXX*, 19:3, pp. 00–00, https://doi.org/10.1386/ta.