3D Printed, Self-glazed Ceramics: An Investigation Inspired by Egyptian Faience

Katie Jayne Nash

A thesis in partial fulfilment of the requirements for the degree of Doctor of Philosophy

Faculty of Arts, Creative industries and Education,
University of the West of England

January 2018

DECLARATION

This thesis is submitted to the faculty of Arts, Creative Industries and Education at the University of the West of England, in partial fulfilment of the degree of Doctor of Philosophy. It is entirely the authors own work, except where noted, and has not previously been submitted for this or any other awards. This copy has been supplied on the understanding that it is copyright material and that no quotation from this thesis may be published without proper acknowledgement.

Acknowledgements

Firstly, I would like to thank the Arts and Humanities Research Council (AHRC), the University of the West of England (UWE) and Professor Stephen Hoskins for giving me the opportunity to undertake this research, which I have thoroughly enjoyed working on for the last 4 years.

I owe a big thank you to my first supervisor David Huson, for his guidance, ceramics knowledge and technical expertise which have been invaluable to this PhD. I am particularly grateful for all of the lengthy technical discussions that we have had over the years that have never failed to motivate or inspire me.

I also want to thank my second supervisor, Dr Peter Walters for his unwavering support and friendship throughout my time at UWE. I am extremely grateful for the countless hours that he has spent reading through this work, always providing feedback that has left me feeling positive, optimistic and motivated.

Thanks also to Professor Norman Ratcliffe, for his continued support and guidance throughout my PhD and for offering me help, advice and guidance when I have needed it most.

I am very grateful to Dr Zahed Tajeddin for sharing his research and expertise with me, especially his anthropological study of an Iranian faience workshop, which provided a valuable insight to the cementation glazing technique also explored within this research.

Thanks also to my fellow PhD students and associates at CFPR. I have thoroughly enjoyed working with you all over the last four years.

Finally, I would like to thank my husband, family and friends for all of their support and encouragement throughout this experience and for never letting me give up.

Abstract

This thesis investigates the potential for developing 3D printable ceramic materials inspired by an ancient Egyptian ware known as faience. Faience was produced in Egypt and the near east from the 4th millennium BC and was the first glazed ceramic material to be produced by man. Valued for its optical properties and likeness to Turquoise and Lapis Lazuli, faience was used to produce a wide range of artefacts including jewellery, statuettes and ceremonial objects for several thousands of years. It is known that Egyptian faience is difficult to work with in paste form, primarily due to a lack of plasticity, resulting from a virtually clay-free body. However, the unique composition of faience enables this material to be vitrified and glazed in one firing compared to at least two firings typically required for conventional ceramics. Additionally, some faience techniques are self- glazing, due to the fact that a glaze medium is not applied directly to the ware. Instead, glazing occurs as an inherent part of the faience material composition and processing steps.

Archaeologists have identified three glazing techniques used to produce faience. These are known as efflorescence, application and cementation glazing. This research has successfully developed and tested 3D printed faience compositions focussing in particular on the cementation method, a unique glazing technique that involves objects being packed into a ceramic container (saggar), surrounded by a glaze powder and then fired. Additionally, a highly vitrified ceramic composition was explored in combination with 3D printing. This material was initially inspired by a ceramic-glass hybrid which Victorian Archaeologists believed to be a variant of faience. However, limitations of this material led to the development of an alternative, Parian-inspired composition. This ceramic ware was developed in the 19th century and was favoured for its likeness to marble. This research has successfully demonstrated to a proof of principal stage, that 3D printing techniques can be used to overcome some of the forming issues associated with faience. Additionally, the challenges and limitations of the materials and processes developed within this research have been identified and opportunities for further research in this area have been proposed.