Laser Cleaning of Avian Eggshell

L. Cornish*, A. Ball, and D. Russell

The Natural History Museum, Cromwell Road, South Kensington SW7 5BD UK
* L.Cornish@nhm.ac.uk.

Summary. A low vacuum SEM was used to evaluate the effect of using an Nd:YAG laser as a non-contact technique for cleaning avian eggshells. The technique shows potential, since there are no obvious deleterious effects from cleaning, but further study is required to understand how the laser is interacting with the sample surface.

20.1 Introduction

Surface cleaning of museum objects is a frequently performed task in conservation. Since the 1970s interest has developed in the use of alternative non-contact methods of treatment [1]. This is primarily in response to the fragility of some surfaces and the invasive nature of more traditional methods, such as mechanical and chemical cleaning. In chemical cleaning for example there is often surface penetration and the chemical action can continue long after the chemical has apparently been removed [2]. Laser cleaning is one such non-contact method and it is fast becoming an established cleaning method for certain types of museum object, e.g. historic buildings, monuments and sculpture. The use of lasers to clean natural history material is a more recent innovation with comparatively few publications and has yet to become fully recognized as an established cleaning technique.

20.2 Background

A disadvantage for many conservators is the high costs involved in purchasing and maintaining a laser. In 1999 a Joint Research Equipment Initiative was set up between the Natural History Museum, Imperial College of Science, Technology and Medicine, the Victoria and Albert Museum, The Royal College of Art and the Tate Gallery. A grant application was submitted to the Engineering and Physical Sciences Research Council for funds to aid the purchase of a portable Q-switched Nd:YAG dual wavelength laser (1,064/532 nm) cleaning
system. The application was successful and the participating institutions share equal time on the laser [3]. The Q-switched Nd:YAG dual wavelength laser was chosen by the group, as it is the most commonly used laser for cleaning in conservation, emitting the most appropriate wavelength and energy of radiation for selective cleaning of a wide variety of surfaces [4]. The Q-switched laser is found to be very effective for cleaning natural history objects [5]. The Q-switch acts as an extremely high-speed shutter and shortens pulse length of the laser. This results in an extremely intense pulse of energy with very short pulse duration (5–10 ns). The short pulse length ensures little or no temperature rise in the underlying surface and, therefore little risk of thermal damage.

20.3 The Avian Eggshell Project

The Walter Rothschild Zoological Museum in Tring, Hertfordshire is home to the ornithological research collections and library of The Natural History Museum (NHM). The ornithological collections are amongst the largest and most comprehensive in the world. There are approximately 1,000,000 eggs, with an additional 2,000 nests. The collection is consulted by researchers throughout the world. The cleaning of eggshell is a difficult task due to fragility of the surface. Older collections are considered to be more vulnerable due to the effects of aging and therefore the current policy is that eggs are not cleaned. The evaluation of a non-contact cleaning method such as the laser was therefore considered to be an important progression in improving the standards of the egg collections.

The eggs loaned from the NHM for laser evaluation came in-part from the collection of the English Portuguese naturalists, William Chester Tait and Alfred Welby Tait. The collection is important as it also includes extensive documentation which records the development of Tait’s interest in Portuguese birds. Tait’s egg collection is of considerable importance both historically and scientifically as very little oological material from Portugal is known. The collection is unfortunately very dirty having been neglected for many years prior to its arrival at the NHM. Two of the Scops Owl (Otus scops scops) eggs, collected in 1878 were selected for use in the evaluation. Many eggs also contain pigmentation on their surface and it was decided to extend the study by testing such areas on a Guillemot egg (Uria aalge) to see if the laser affected the pigmented areas more than the unpigmented areas.

Eggshell is not a homogeneous structure. It is composed of an organic matrix, or framework, of delicate interwoven fibres, and an interstitial substance composed of a mixture of inorganic salts. The proportions of these constituents vary in the eggshells of different species of birds. The organic matrix is a collagen-like protein and the minerals are mainly carbonates and phosphates of calcium and magnesium, of which calcium carbonate is the most plentiful. There are also minute pores within the eggshell which are filled with