DIRECT AND REMOTE VISUAL TESTING

Welcome to *Materials Evaluation*'s Technical Focus Issue on the nondestructive evaluation (NDE) method of visual testing (VT). Enhancing the attention given to the VT method, for both direct and indirect techniques, has been a career-long goal of mine. It is an honor and privilege to serve as the guest editor for this special issue in the ever-evolving landscape of VT. This NDE method has come a long way from using a flashlight, magnifying glass, six-inch scale, and a dental mirror for direct visual testing (DVT) of various metallurgical products, to the complex world of digital remote visual inspection (RVI) with a myriad of applications.

Advanced VT technologies enable the modern inspector to address the inspection needs of a number of major industries. Several industries have utilized VT/RVI techniques to examine piping systems with crawlers, power plant heat exchanger tubing with push tube cameras, aerospace engines with videoscopes, reactor containments with telescopes, and assembly line components with image-enhanced measurement techniques.

The VT method has evolved from line-of-sight direct access, aided by magnifiers and mirrors, to indirect techniques such as telescopes, rigid borescopes, flexible fiberscopes, electrical pulses imaged by charge-coupled device (CCD), computer-processed images, and AI-assisted evaluations. We can now extend far beyond what the human eye can directly see, using images captured by advanced technology and interpreted by the brain.

This special issue brings together a diverse range of contributions from experts in power generation, gas turbines, the automotive industry, and the petrochemical industry, focusing on VT personnel qualification and certification methodologies.

Electric power generation plants—whether nuclear, fossil, hydro, or wind power—and gas turbines have all been inspected using VT/RVI techniques for decades. Any system or component experiencing loose parts falling into unwanted spaces has relied on the expertise of remote visual inspectors. These inspectors possess the special skills of a puppeteer and the ability to operate using indirect images to retrieve loose parts, a service provided by the RVI industry.

I am grateful to the authors whose dedication and expertise have enriched this special issue. The compilation of varied applications and the insights gained from these challenges will serve as a valuable resource for professionals, researchers, and practitioners involved in the dynamic realm of VT and RVI across a wide range of applications. Thank you for your interest and support.

It is an honor and privilege to serve as the guest editor for this special issue in the ever-evolving landscape of visual testing.

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LASER TECHNOLOGY OFFERS BREAKTHROUGH IN DETECTING ILLEGAL IVORY

A new way of quickly distinguishing between illegal elephant ivory and legal mammoth tusk ivory could prove critical to fighting the illegal ivory trade. A laser-based approach developed by scientists at the Universities of Bristol and Lancaster could be used by customs worldwide to aid in the enforcement of illegal ivory from being traded under the guise of legal ivory.

Despite the Convention on the International Trade in Endangered Species (CITES) ban on ivory, poaching associated with its illegal trade has not prevented the suffering of elephants and is estimated to cause an 8% loss in the world's elephant population every year. The 2016 African Elephant Database survey estimated a total of 410 000 elephants remaining in Africa, a decrease of approximately 90 000 elephants from the previous 2013 report.

While trading/procuring elephant ivory is illegal, it is not illegal to sell ivory from extinct species, such as preserved mammoth tusk ivory. This legal source of ivory is now part of an increasing and lucrative "mammoth hunter" industry. It also poses a time-consuming enforcement problem for customs teams, as ivory from these two different types of tusks are broadly similar, making it difficult to distinguish from one another, especially once specimens have become worked or carved.

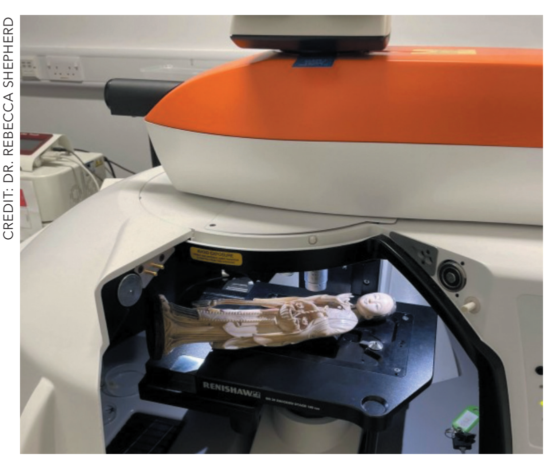
In this new study, scientists from Bristol's School of Anatomy and Lancaster Medical School sought to establish whether Raman spectroscopy, which is already used in the study of bone and mineral chemistry, could be modified to accurately detect differences in the chemistry of mammoth and elephant ivory. The nondestructive technology, which involves shining a high-energy light at an ivory specimen, can detect small biochemical differences in the tusks from elephants and mammoths.

Researchers scanned samples of mammoth and elephant tusks from London's Natural History Museum using the laser-based method Raman spectroscopy. Results from the experiment found the technology provided accurate, quick, and nondestructive species identification.

"The gold standard method of identification recommended by the United Nations Office on Drugs and Crime for assessing the legality of ivory predominantly are expensive, destructive, and time-consuming techniques," said Dr. Rebecca Shepherd, formerly of Lancaster Medical School and now at the University of Bristol's School of Anatomy. "Raman spectroscopy can provide results quickly (a single scan takes only a few minutes) and is easier to use than current methods, making it easier to determine between illegal elephant ivory and legal mammoth tusk ivory. Increased surveillance and monitoring of samples passing through customs worldwide using Raman spectroscopy could act as a deterrent to those poaching endangered and critically endangered species of elephant."

CREDIT: BEN BOOTH

A selection of elephant and mammoth tusk samples.



CREDIT: DR. REBECCA SHEPHERD

An ivory object, assumed to be of Asian elephant origin, under the microscope inside a research-grade Raman spectrometer.