

## Nanochemistry of artists' materials

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In the last decade thanks to the exploitation of advance analytical methods heritage scientists have unveiled that unusual colour were produced by nanotechnologies. Indeed the use of metallic nanoparticles seems to have started with the beginning of glass-making in Egypt and Mesopotamia back in the fourteenth and thirteenth centuries BCE [1]. The most famous example of the use of metallic nanoparticles concerns the Lycurgus Cup, dating from the fourth century CE, at the British Museum in London. Transmission electron microscopy and X-ray analysis have revealed that its red-green dichroism is due to the presence of silver-gold alloy nanoparticles [2]. Also, lustre technology, of the most fascinating secrets of ancient ceramists of Middle Ages and Renaissance is based on the formation of a thin layer of silver and/or copper nanoparticles formed underneath the first nanometers of the glaze surface. Optical properties of lustre are explained in terms of models that take into account surface plasmon resonances of the nanoparticle dispersions and interferences in reflections [3]. Another example of ancient nanomaterial is Maya Blue that can be considered as a precursor of modern nanocomposite materials, in which an organic guest, indigo, is incorporated in a host framework, palygorskite, a clay having a superlattice nanostructure providing a stable and long-standing pigment. The stability of Maya Blue has been attributed to the hydrogen-bonded organic–inorganic complex formed by indigo molecules in the channels of the clay structure. The unveiling of nanochemistry of Maya Blue has recently inspired the design of novel hybrid pigments with different hues substituting indigo with other dyes as well as palygorskite with zeolite-like host [4].

[1] D. Schaming, H. Remita, *Found Chem* 2015

[2] I. Freestone, N. Meeks, M. Sax, C. Higgitt, *Gold Bull.* 2007

[3] B.Brunetti, L.Cartechini, C.Miliani, A.Sgamellotti, *Metal Nanoparticles in Glass: Lustre*, in *Modern Methods for Analyzing Historical Glass*, John Wiley & Sons, 2013

[4] L.Bertrand, C.Gervais, A.Masic, L.Robbiola, *Angewandte Chemie*, 2018