Preliminary syllabus for:
SCIENCE FOR CONSERVATION: FUNDAMENTALS AND APPLICATIONS
By Emiliano Carretti

Week 1

Day 1

The works of art as thermodynamic systems

The degradation of a work of art from a thermodynamic point of view: kinetics and thermodynamics aspects of a degradation process

Some basic concepts preparatory to the course

Basic associated aspects of physical chemistry for Conservation

-Relative Humidity (RH): the dew point. Measurement of RH
-Wettability of a surface: the contact angle of homogeneous and not homogeneous surfaces. Young equation. Measurement of the contact angle
-Capillarity. The basic laws of capillarity. Capillary condensation
-What is a solution? concentration, ionic strength and activity
-Intermolecular interactions
-Hildebrand and associated parameters: measurements of polarity of solvents

Day2

Instrumental techniques commonly used for the analysis of the composition and of the conservation status of a work of art: basic principles and applications

-Infrared spectroscopy (FTIR)
-Dept profiles for solid surfaces: cross-sections
-Optical microscopy
-Scanning Electron Microscopy and Elemental analysis
-Chromatography

Surfaces of objects of artistic interest to be discussed

Natural and artificial stone materials

Days 3 and 4

-Chemical classification of natural lithotypes
-Structure and chemistry of a mortar
-Structure and chemistry of wall paintings with particular attention to frescoes

Degradation of stone material with particular attention to the role of H_2O

-Physical degradation: wind, temperature and RH
-Chemical degradation with particular attention to the role of air components
    -Origin and effects of salts. The colligative properties: the depression of freezing point in the presence of salts
    -Black crusts
-Biological degradation

Monitoring the conservation status of a stone made artifact through instrumental techniques

Day 5

The conservation of works of art: the role of nanotechnologies

Hard matter

Syntheses of nanoparticles
Theory of the nucleation and growth of crystals for material preparation
Different approaches and procedures
-Top to bottom approaches
-Bottom to top approaches

Week 2

Day 6

Consolidation and surface protection of stone materials using nanotechnologies
-Consolidation of limestones and mortars: traditional and newer methods
-Polymeric materials
-Barium method
-$Ca(OH)_2$ nanoparticles
-Ammonium oxalate
-Consolidation of silicate stones: TEOS and derivatives

Day 7

Cleaning of a stone-made artifact
-Traditional methods: the solubility triangle (Teas plots)
-Newer nanotechnological methods: nanostructured fluids: o/w microemulsions and micellar solutions
-What is a surfactant? chemical structure and properties of surfactants); formation of micelles, Krafft point, cloud point, hydrophilic-lyophylic balance, packing parameter
-What is a microemulsion: structure and phase diagrams
Application of nanostructured fluids for cleaning stone made artifacts: some case studies

Days 8-10

Easel paintings: structure, chemical composition of their stratigraphy and their properties with particular attention to the paint layer

Degradation of easel paintings
Cleaning of easel paintings
Traditional methods: liquid solvents; Teas plots
What is a gel? Definitions-mechanical and structural properties of gels
Analyses of a gel at different distance and mechanical scales: Small Angle Scattering techniques and rheology
Gels vs neat solvents: advantages and limits
The use of gels for the cleaning of easel paintings
Traditional gels
Newer gels
Application of gels for the cleaning of easel paintings: some case studies