



FACULTY OF HUMANITIES

Programme Conservation and Restoration of Cultural Heritage

Metallography

A master class by dr. Carla Martini

Overview

Metallography is the study of metal microstructure using microscopy techniques. Why study microstructures? Because microstructure is the language of metals, it can tell us about the changes they undergo during their lifetime. The aim of this course is to provide basic knowledge of metallography for metals encountered in the field of cultural heritage. The main metallurgical features related to microstructure generation will be discussed, enabling the participants to understand how metal microstructure is influenced by solidification and the manufacturing processes carried out in pre-modern technological conditions. Lectures will be followed by practical activities (carried out each day in the afternoon), to ensure participants become familiar with the main metallographic preparation techniques in the field of cultural heritage diagnostics. Upon completing of the course, the participants will be able to understand which questions can (and can not) be answered by metallographic investigations on cultural heritage metals, as well as how to interpret such answers.

This master class is part of the regular master's program in conservation and restoration.

Instructor

Mrs. Dr. Carla Martini

Is an Associate Professor at the University of Bologna in Italy. Her full CV can be found at <http://www.unibo.it/faculty/carla.martini>.

Dates

Four full time days: 1-4 June 2015.

Venue

Ateliegebouw, Hobbemastraat 22 in Amsterdam. The Ateliegebouw is situated next to the Rijksmuseum.

Costs

Courses fees are € 625,00. Participants are responsible for all evening meals, accommodation and transportation. Lunches will be provided in the restaurant of the Ateliegebouw.

Language

The course will be given in English. Participants are advised that a basic knowledge of scientific terms in English is required.



Programme (timetable, see next page for table of contents)

June 1st, Monday

09:00 – 12:00 Basics on microstructure (lecture 1.1 - 1.3)

14:00 – 17:00 Metallographic techniques (lecture 1.4); cold mounting of selected specimens (practical)

June 2nd, Tuesday

09:00 – 12:00 Microstructure of Cu alloys (lecture 2.1 - 2.3)

14:00 – 17:00 Practical: Metallographic preparation of specimens mounted on Monday; observation of Cu alloy samples (already prepared and supplied by the teacher)

June 3rd, Wednesday

09:00 – 12:00 Microstructure of Fe alloys (lecture 3.1 - 3.3)

14:00 – 17:00 Practical: Metallographic preparation of specimens mounted on Monday (continued); observation of cast-iron and steel samples (already prepared and supplied by the teacher)

June 4th, Tuesday

09:00 – 12:00 Microstructure of precious alloys and low-melting point metals (lecture 4.1 - 4.2, 5.1)

14:00 – 17:00 Practical: Etching and documentation of specimens mounted on Monday; discussion of observed microstructures and conclusions



Lectures: table of contents

	<i>Unit (45-60 min)</i>	<i>Contents</i>	<i>Main references</i>
Day 1	1.1	Understanding microstructures: phase diagrams (total solubility; partial solubility with eutectic/eutectoid constituents; intermetallics)	• D.R. Askeland, The Science and Engineering of Materials
	1.2	Understanding microstructures: grain morphologies due to solidification (pure metal/alloy) or to plastic deformation (slip bands, mechanical twins)	• W.D. Callister, Materials Science and Engineering: An Introduction
	1.3	Understanding microstructures: thermal effects (recrystallisation due to annealing)	
	1.4	Metallographic preparation (sectioning, mounting, polishing, etching and image analysis)	• ASM Handbook vol.9, Metallographic Techniques
Day 2	2.1	Cu alloys: Cu-As and Cu-Sn phase diagrams with typical microstructures.	• ASM Handbook vol.3, Alloy Phase Diagrams
	2.2	Cu alloys: Microsegregation phenomena. Pb in bronzes and corresponding microstructures. Bronze tinning.	• D.A. Scott, Metallography and microstructure of ancient and historic metals, The J.P. Getty Trust, Singapore 1991.
	2.3	Cu alloys: Cu-Zn phase diagrams with typical microstructures. Brass production in ancient times and authenticity issues.	• P.T. Craddock (ed.) (1990), 2000 Years of Zinc and Brass, British Museum, London 1990
Day 3	3.1	Fe alloys: iron smelting and microstructures of low-C steels in the Fe-C phase diagram; out-of-equilibrium martensitic structures.	• W.D. Callister, Materials Science and Engineering: An Introduction
	3.2	Fe alloys: microstructures of cast iron in the Fe-C phase diagram	
	3.3	Fe alloys: microstructures of cultural heritage objects (rivets, nails and wrought iron joining elements; carburizing in ancient times: blades and Japanese swords; cast iron cannons and cannon balls)	Multiple references (listed in course material)
Day 4	4.1	Au alloys: Au-Cu and Au-Cu-Ag alloys; metal gilding.	Multiple references (listed in course material)
	4.2	Ag alloys: Ag-Cu phase diagram and typical microstructures; examples from silver coinage.	Multiple references (listed in course material)
	5.1	Pb, Sn and Zn alloys: Pb-Sn phase diagram and main microstructures (solders, pewter, organ pipes); Zn in memorial statues.	Multiple references (listed in course material)



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Participants

Number of Participants: maximum 2. Registration is open to restorers, conservation scientists and related professionals practicing within the field.

How to apply

Please send a signed application form by mail or e-mail, addresses are mentioned on the attached registration form. The Programme Conservation and Restoration of Cultural Heritage aims to compose a list of participants of whom the level matches each other's as much as possible. For that reason, we would like to receive your resume. **The deadline for application is April 1st, 2015.**

Once you have registered you will receive a confirmation plus information for payment. Your registration is final when we have received the course fee.

Contact

Please contact Angèle Goossens (coordinator continuing education) and Rosa Hoogenboom (secretariat continuing education) by e-mail pe-CenR@uva.nl or telephone +31 (0)20 525 2015 with any further queries.