Corso di Dottorato Nazionale in Heritage Science, Università la Sapienza

Ciclo XXXVIII

# Studies of nanotechnological tools for ancient wood conservation


***Matteo Vercelli***

*DiSVA, Laboratorio Biofisica Molecolare*

*Tutor: Prof. Francesco Spinozzi*

*Co-tutors: Dr. Claudia Mondelli, Prof. Giuliana Taglieri*


## Introduction

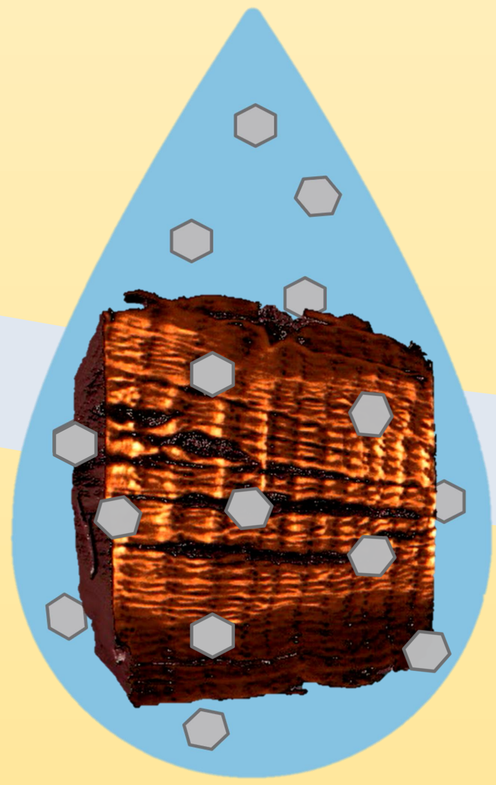
The major problem of wood's artifacts is the great degradation that acts on these material due to different factors. This is particularly evident in the ancient wooden ships. Of the two main components of wood, cellulose and lignin, only cellulose is degraded by bacteria, algae and fungi, while lignin, which preserving the wood's internal structure, leads to a high fragility of the wreck. For these reasons, wooden artifacts recovered from submerged or underground environments, are treated with a poly-ethylene-glycol (PEG) solution, which penetrates in wooden fibers and give a support to the lignin structure [1]. Moreover, there are iron's residues in areas of wood where nails as well as decorations were present. These residues could react with sulphur, which is introduced by the metabolism of anaerobic bacteria, to originate compounds such as pyrite. These products represent not only a risk till anoxic environments persist, but, in the presence of oxygen or in particular conditions of temperature and humidity, they can be oxidized and thus form sulphuric acid, which causes an irreversible and visible degradation of the wood. We focused on the use of Calcium Hydroxide NanoParticles (CH-NPs) which have basic characteristics. Their deacidification power was verified by conducting studies on small samples of wreck wood. The very promising results suggest that the CH-NPs treatment is able, in a single step, to stop the acidification and to create a stock of NPs which prevents further degradations [2-3-4].

## Aim

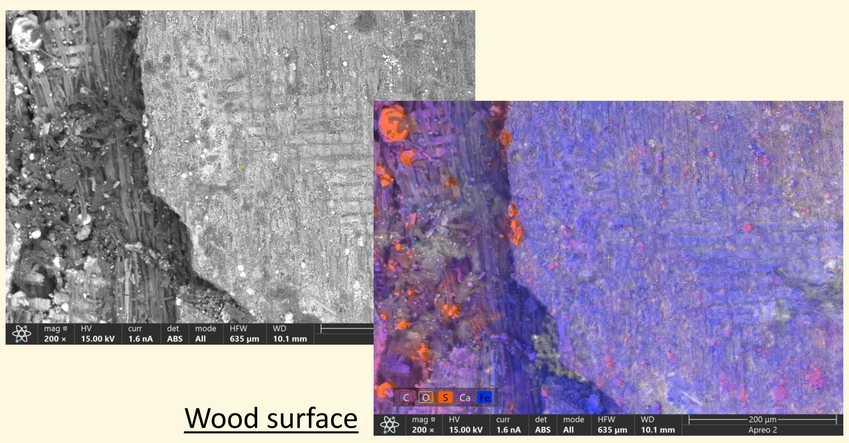
- Verify the curative and preventive effectiveness of NPs on wood deacidification
- Apply NPs with different methods and in different conditions and study the depth reached by theme through wood fibers
- Identify the species of wood to compare NPs penetration on several kinds of wood


## Results

- ✓ SEM-EDX
- ✓ FTIR
- ✓ Neutron Imaging
- XRD
- Raman



## SEM-EDX

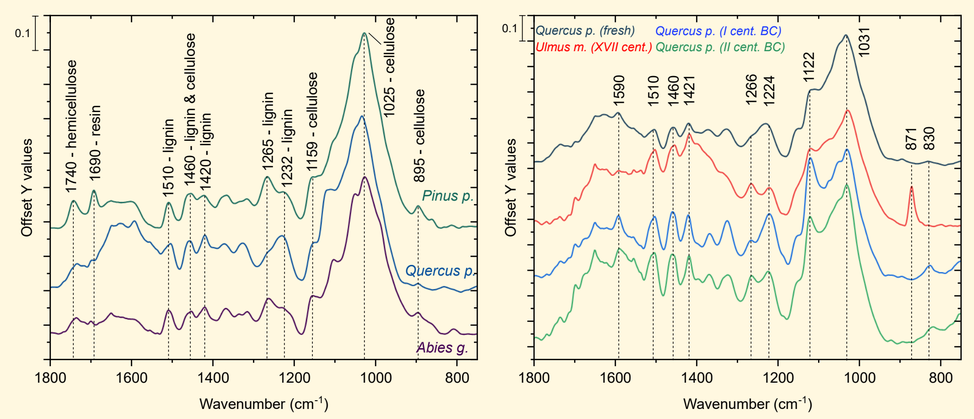



Wood surface




Deep in wood

## FTIR

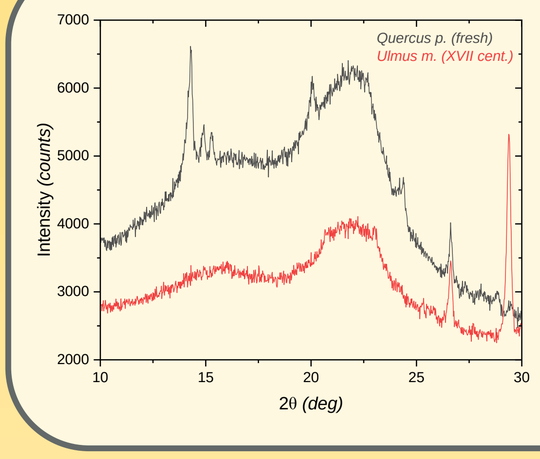



## Neutron Imaging

SCAN ME

- DINGO @ ANSTO
- Porosity measurement
- Study the absorption of NPs through wood fibers

## XRD




## Conclusions

- ➢ We characterized the untreated wood structure
- ➢ With SEM-EDX we saw the distibution of iron, sulphur and their association
- ➢ With FTIR and XRD we evaluated the state of degradation of wood and we noticed a decrease of cellulose in archeological wood
- ➢ We will continue with NPs treatments and relevant analysis


*References*

1. Stramm, J A. Forest Product Research Society, 5, 201-204 (1956).
2. Giorgi, R et al. Langmuir 21, 10743-10748 (2005).
3. Taglieri, G et al. Nanomaterials 10, 1744-1753 (2020).
4. Volpe, R et al. Europen Patent, EP2880101, 2016.