Puu-19.4010

Spring 2008

LABORATORY REPORT – INSTRUCTIONS

First, describe your sample and what you expected from it.

Divide the report in sections which correspond to the applied method. In each section, first describe briefly the theoretical aspects (principles, just a few sentences) and the practical work performed in each technique. When exposing the results, try to explain why a particular technique yields particular information on the sample (based on the principles of each technique).

Points of special attention in each technique:

IR spectroscopy

- Compare PAS and ATR sampling methods: do the methods result in different spectra? If so, why (sampling depths)? And if not, why not?
- Try to address the origin of main peaks (cellulose, hemicellulose, lignin, extractives, filler, pigment, binder); here it is worthwhile to use the information from the other techniques as well

Raman spectroscopy

- Compare Raman and IR spectra? Why are they different? Which peaks are emphasized in Raman spectra and why? Likewise, which peaks are emphasized in IR spectra and why?

XPS

- Compare XPS with other surface sensitive techniques, like ATR-IR and EDX. How is the information from XPS different and why? Compare the inorganics composition on the surface to the inorganics composition in the bulk (as analysed by ICP-AES).

- Compare the organic composition from XPS high-resolution C 1s emission with a “bulk” organic analysis of photoacoustic IR.
- Why is the surface composition different? Why are certain elements or organic groups enriched on the surface?

ICP-AES

- How does the quantitative inorganic analysis correspond to the microscopic analysis: what kind of filler or pigment contents would you expect from SEM or AFM and how does the ICP-AES analysis correspond to this?
- What is the origin of each element analysed by ICP-AES?

SEM-EDX

- How does the EDX spectrum correlate with the SEM image? Can you point out some features in the image that would correspond to certain contributions in the EDX spectrum (such as pigment particles)? Are these visible also with IR and Raman?
- Compare the inorganic analyses of EDX, XPS and ICP-AES with special emphasis on the surface sensitivity? How does the surface sensitivity correlate with the suspected origin of the inorganic elements (i.e. why are some elements enriched on the surface)?

AFM

- Compare AFM images with SEM images. What is visible with AFM and what is visible with SEM? Take an educated guess what each topographic feature in the AFM image represents. Use also the knowledge acquired from organic and inorganic surface sensitive analyses.
- Compare height and phase images. This helps further in guessing the origin of the features in the image.
- Discuss the advantages and disadvantages of SEM and AFM, based on your results.

Finally, try to build a detailed description on the chemical and morphological composition of your sample. Suggested structure: (i) organic contents, (ii) inorganic contents, (iii) bulk vs. surface contents, (iv) distribution of the components on the surface. Evaluate how this view correlates with your initial expectations from the sample (the first passage in this report).