

# Cellulose surface modification with organosilanes

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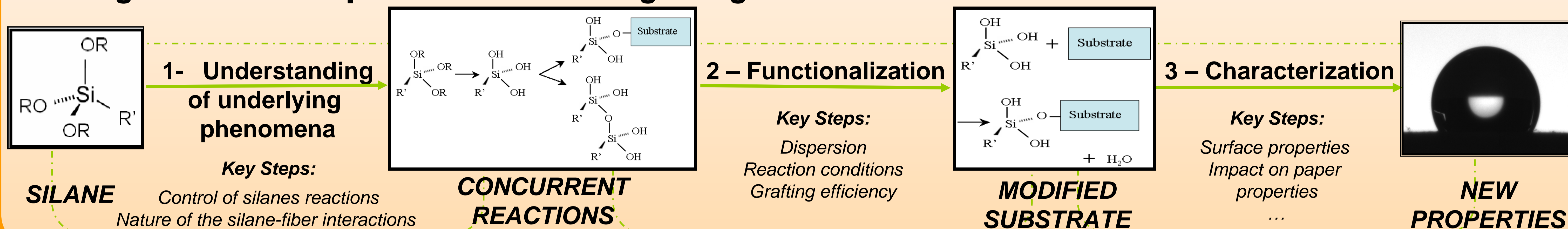
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## Objective

This study aims at functionalizing the surface of cellulose fibers with specific functions by mean of reaction with organosilanes in specific conditions regarding the medium.



## Current work

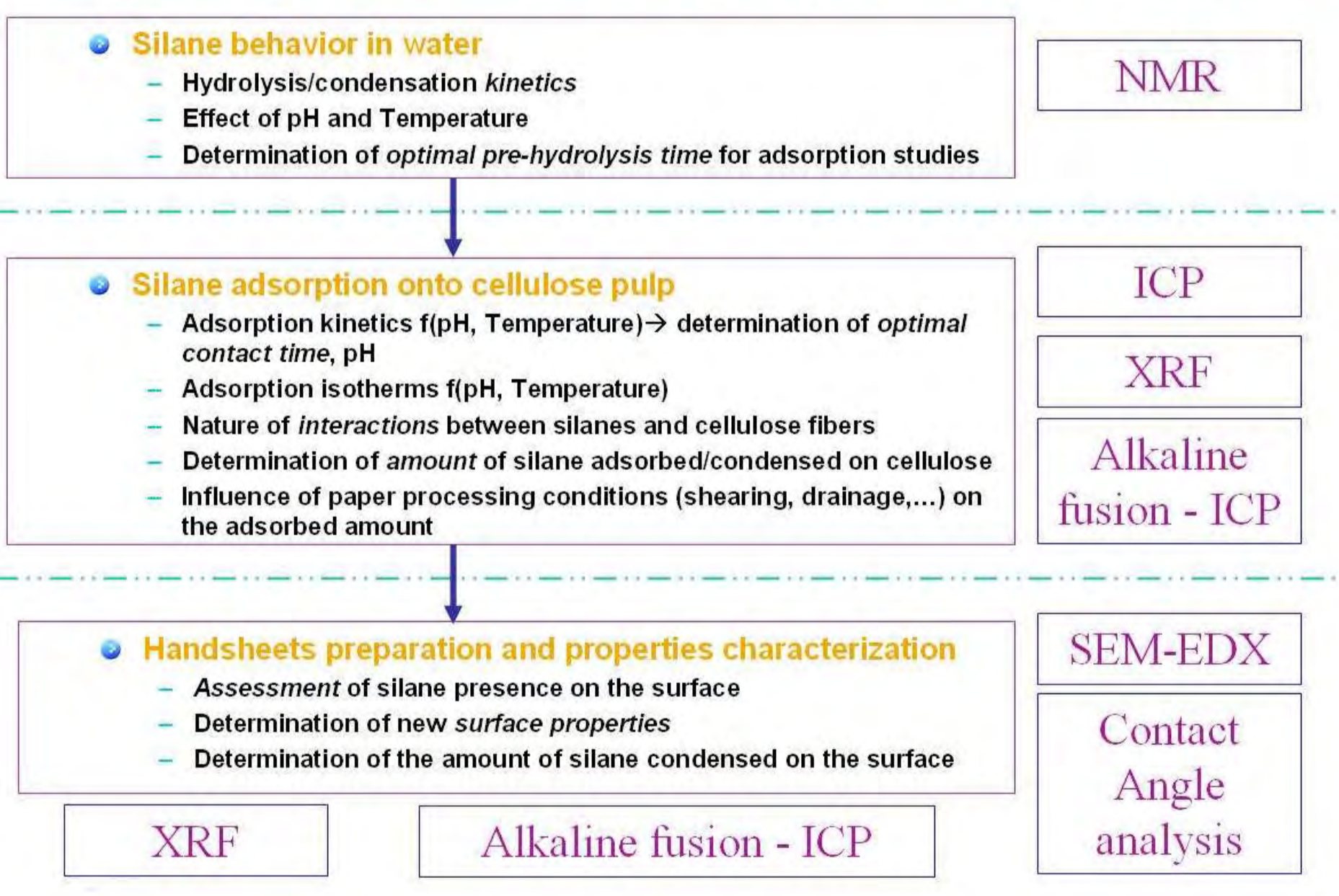
### Introduction

The use of bio-renewable resources is particularly suitable to allow the development of sustainable processes. But cellulose surface properties are detrimental for its use in several applications. The use of organosilane to modify cellulosic resources could allow to tailor their surface properties according to their uses<sup>1</sup>, and bring new uses for these biodegradable natural resources.

### Material & Methods

High purity products were used in this work, including a selection of silanes with various organic moieties. The experimental plan has been divided in three main parts, and analytical tools were selected for each part of the work. The main tools are summarized hereafter:

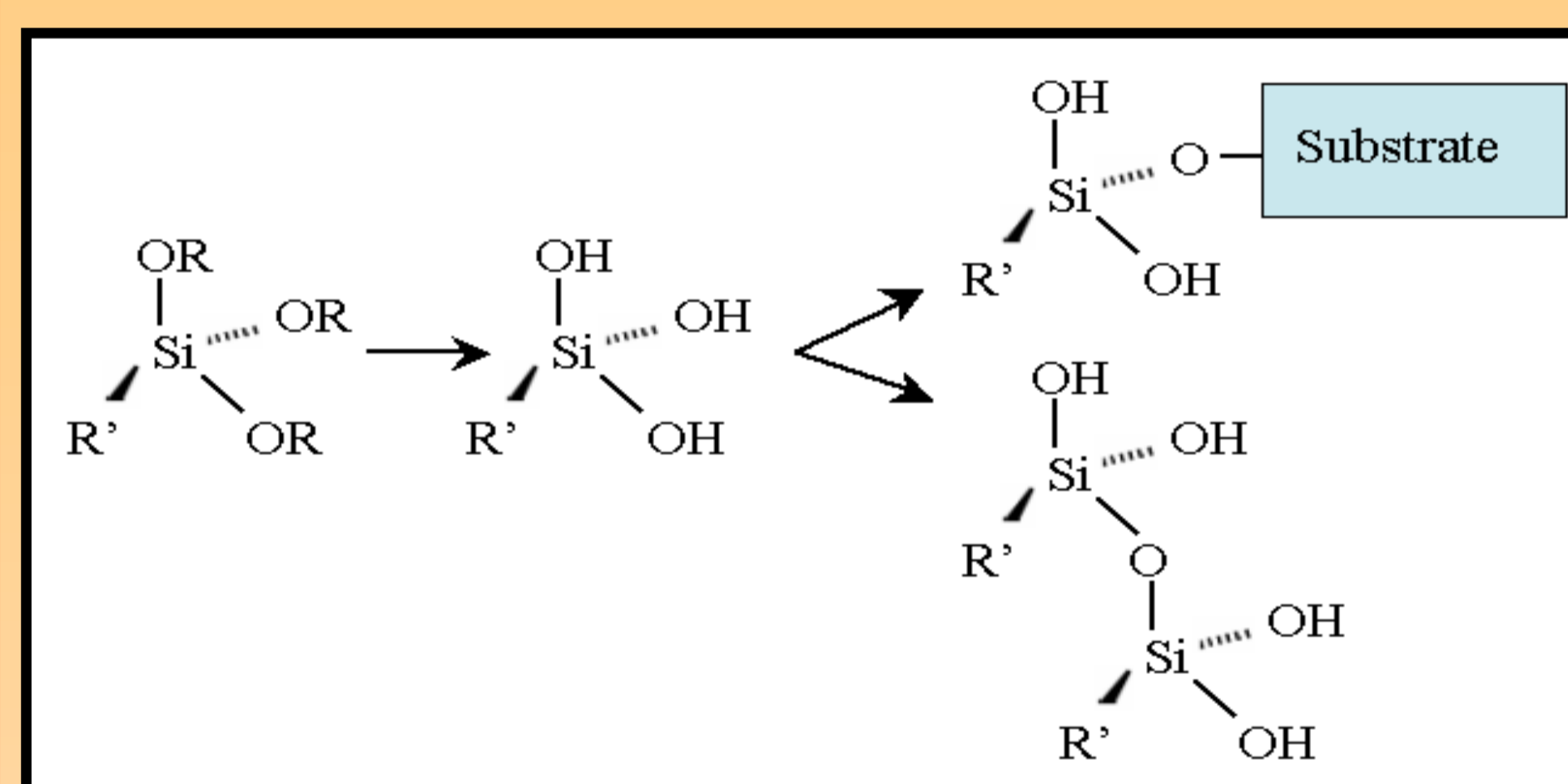
#### Experimental plan – associated analytical means



### Results

The behaviors of all selected silanes in the reaction medium were studied through an extensive study using <sup>29</sup>Si NMR. The parameters influencing the hydrolysis reactions and the concurrent reactions of condensation on substrate and self-condensation (see figure below) were characterized.

These data were compared with prior results from literature (2) allowing a better understanding of the effect of the medium composition.

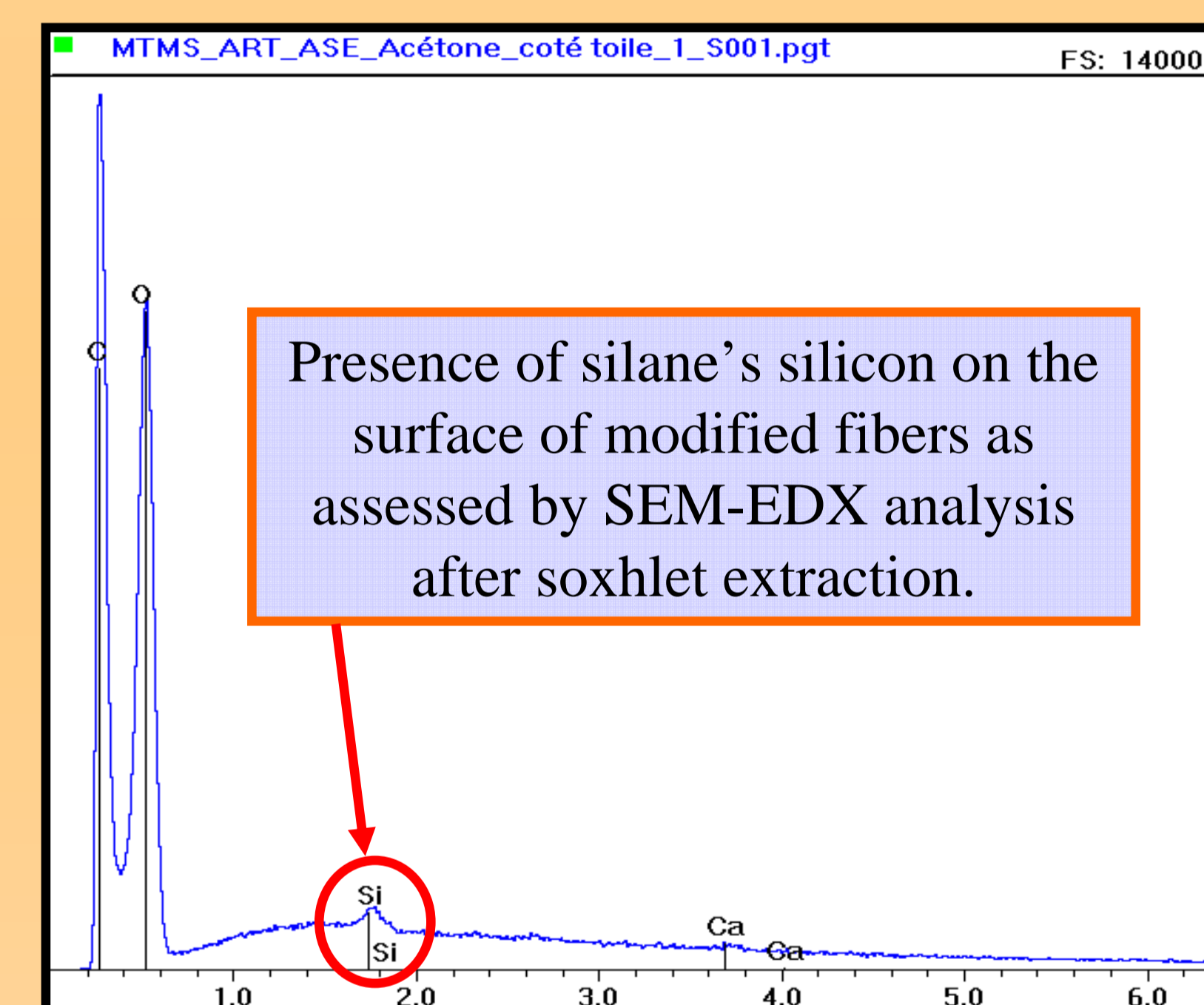


From the data obtained during this study, optimum conditions were selected and the second phase of the study has been initiated, ie the study of the silane adsorption onto cellulose pulp and the interactions between the silane and the substrate (adsorption, covalent bonding, ...).

New evidences on the nature of these interactions were found, confirming literature data<sup>3</sup>.

### Discussion

The first phase of this study being completed, the second phase has been initiated and focus on the parameters influencing the efficiency of the condensation reaction between silanes and cellulose.



In addition to physical and chemical parameters (Temperature, pH, Concentration, ...), the influence of paper processing parameters will be evaluated, especially regarding the influence of water drainage and shearing in the pulp during the sheet formation.

In order to complete this study, another important point is the selection of suitable silanes with organic moieties able to modify the cellulose surface properties and positively impact the potential use of the paper.

Also, the potential impact of the use of organosilanes on the wet-end chemistry may be discussed, as well as the impact of treated fibers on the recyclability of cellulose based materials.

## Conclusion & Perspectives

The behaviors of the reactive compounds used in this work have been successfully characterized, and the study has brought a better understanding of all the reactions occurring in the medium (Hydrolysis, self-condensation of the silane, condensation of the silane onto a substrate). Analytical methods have been developed allowing the characterization of samples at all steps of the cellulose modification. The study will now focus on the modification of cellulose fibers properties using organosilanes and proposing ways of optimize these modifications. The modification of other bio-renewable resources with organosilanes can also be envisaged.

### Acknowledgements

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### References

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