

Daryna Diment¹, Philipp Schlee¹, Oleg Tkachenko², Tetyana Budnyak² and Mikhail Balakshin¹

¹ Department of Bioproducts and Biosystems, Aalto University; ² Division of Nanotechnology and Functional Materials, Department of Materials Science and Engineering, Uppsala University

*Corresponding authors: mikhail.balakshin@aalto.fi; tetyana.budnyak@angstrom.uu.se

INTRODUCTION

Unveiling the interrelation between lignin structure, its properties and performance in specific applications is of primary importance for lignin engineering for high-value products. Herein, we suggest a new efficient methodology to quantitatively evaluate the roles of lignin specific functionalities in selected applications. The method consists in changing only one structural variable at a time, while keeping all others constant prior to performance evaluation.

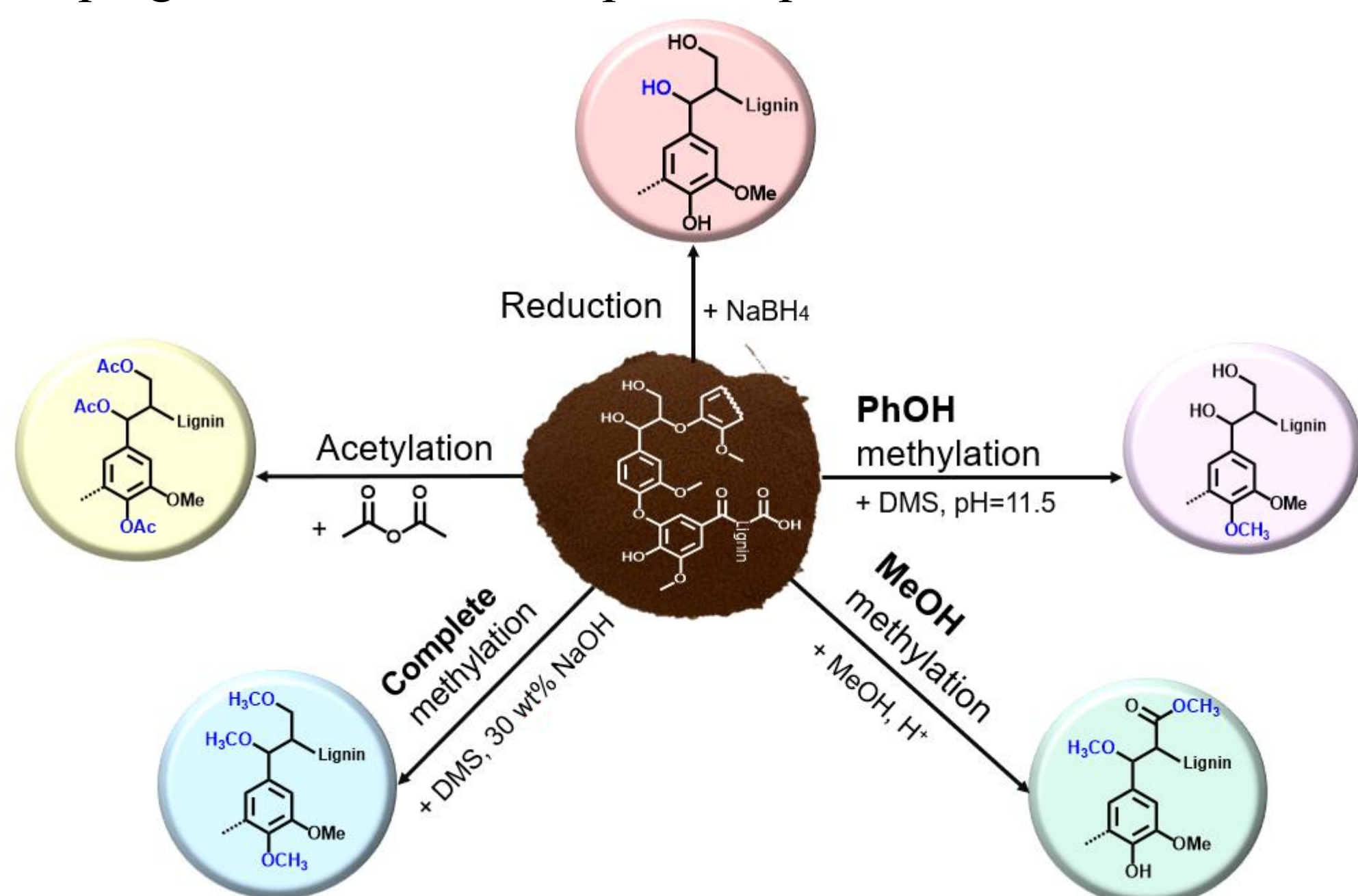


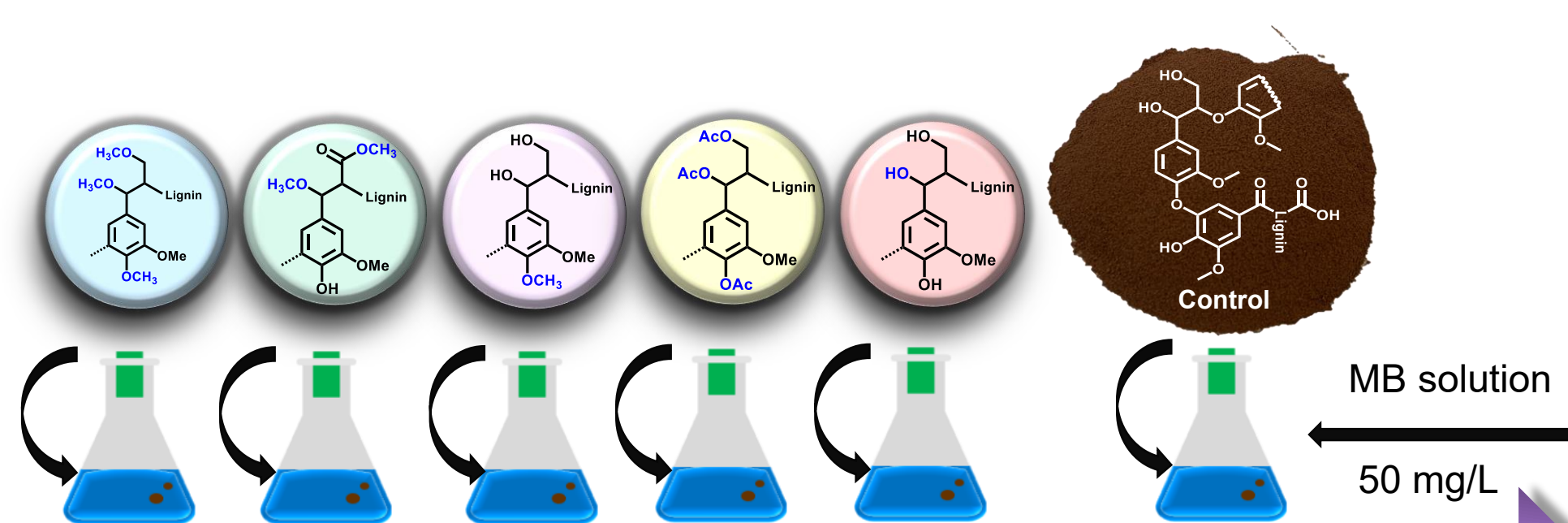
Fig. 1. Reactions used for selective masking of specific lignin functionalities

EXPERIMENTAL

Indulin AT was chosen as a lignin substrate as the main type of commercially available lignin standard (softwood Kraft). The modifications reactions were carried out by earlier developed protocols [1,2,3] (Fig. 1) and analyzed by a comprehensive NMR methodology [2].

Methylene Blue (MB) Adsorption

The aim of the experiment is to elucidate structure – performance correlation. The test was performed by the earlier reported protocol [4] at MB concentration of 50 mg/L.



Differential Scanning Calorimetry (DSC)

DSC was employed to measure the glass transition temperature (Tg).

RESULTS AND DISCUSSION

Lignin performance as a sorbent

- The contribution of OH groups in lignin sorption capacity was crucial.
- The role of the other functionalities (including COOH and CO) was negligible.

Table 1. Amount of main lignin functionalities in Indulin AT (per 100Ar) [5]

PhOH	AliphOH	Sec.OH	β-O-4	Total OH	COOH	CO
66	49	18	7	115	17	15

The contribution of PhOH groups was ~ 50%

The contribution of AliphOH was ~ 50%

Reactivity of an average group

PhOH : BenzOH : AliphOH = 1 : 5.5 : 0.9

*AliphOH does not include BenzOH

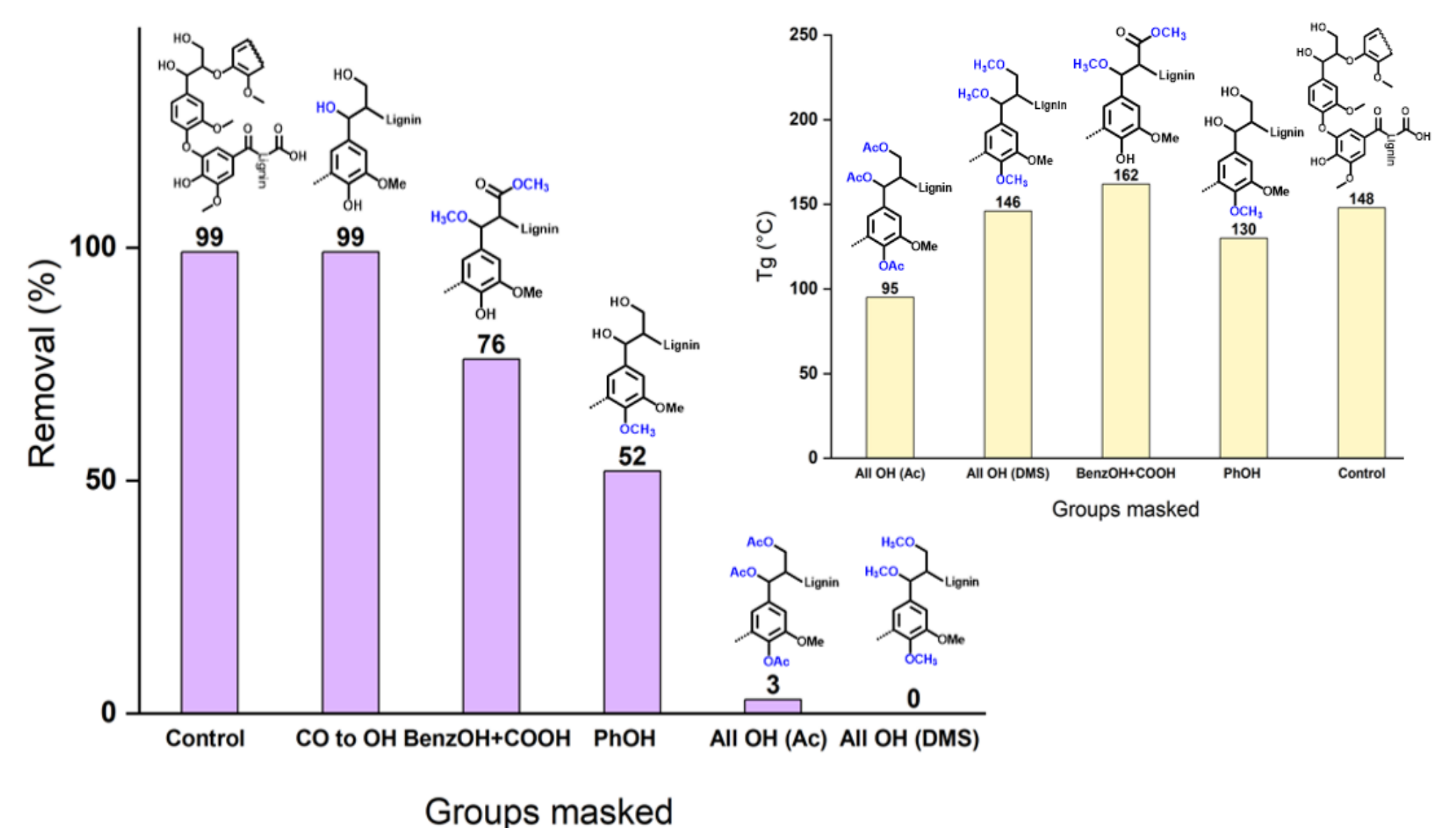


Fig. 2. The effect of lignin functional groups on Tg and sorption performance

Conclusions

- The correlation between specific lignin functionalities based on its Tg and sorption were used as demonstrators.
- OH groups play the key role in lignin sorption performance.
- PhOH and AliphOH contribute equally.
- From the AliphOH groups, the benzylic OH showed the highest activity.

Acknowledgement

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