

## Bio-Based feedstock as renewable sources for low dissipation energy elastomeric composites. Synthesis of pyrrole compounds

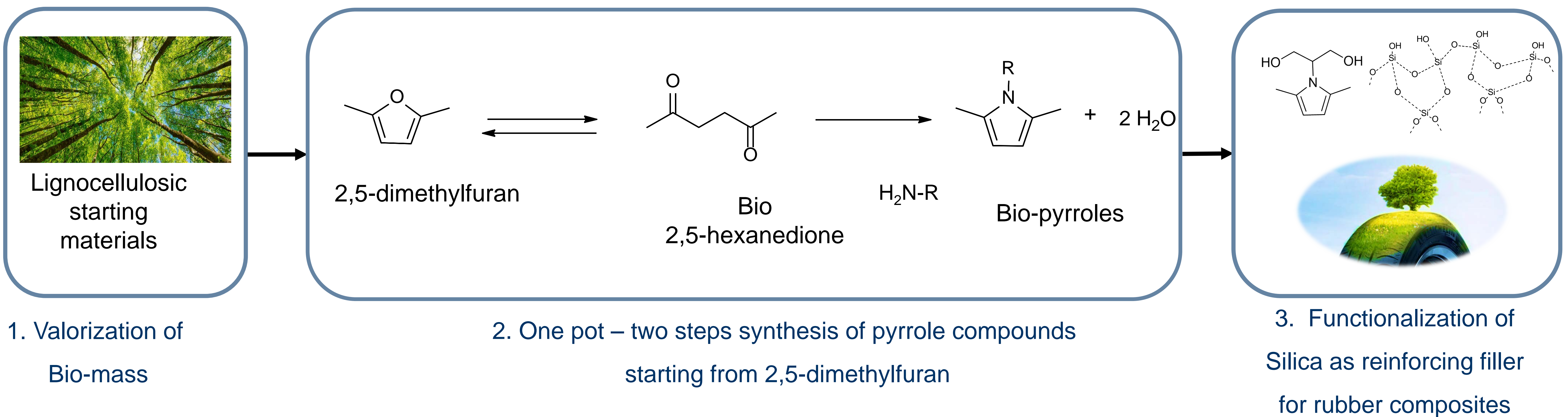
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### Introduction

- Replacement of oil-based chemicals exploiting the high production of bio-masses;
- Chemical transformation of lignocellulosic starting materials for obtaining versatile furan moieties;
- Acid catalyzed ring opening reaction of 2,5-dimethylfuran to 2,5-hexanedione as useful renewable industrial chemical building blocks.

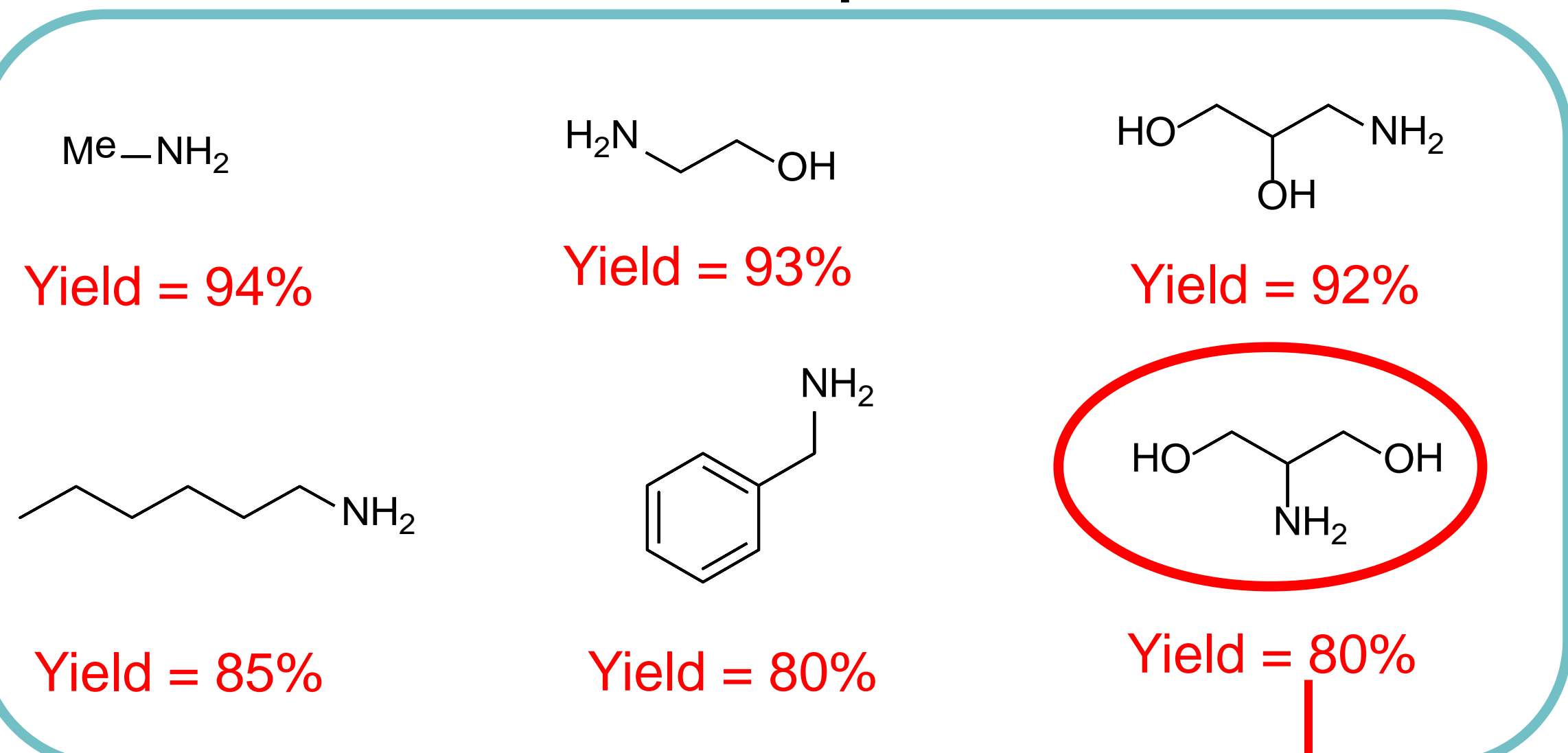
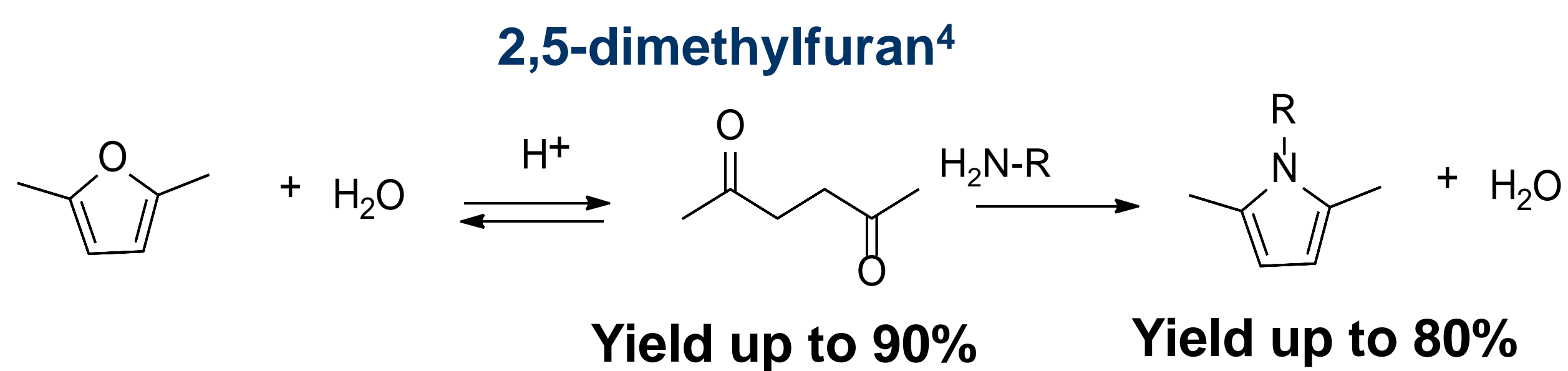
### Objectives

- To replace the oil-based 2,5-hexanedione with new ones totally bio-based as useful io-based building block;
- To develop a novel synthetic pathway for the synthesis of pyrrole compounds starting from 2,5-dimethylfuran;
- To evaluate the potentiality of particular bio-pyrroles as alternative coupling agents in Silica-based rubber composites.



### What has been done

#### a) Synthesis of bio-pyrroles starting from 2,5-dimethylfuran<sup>4</sup>



- No purification for each step is required;
- H<sub>2</sub>O is the only co-product of the entire process



#### 2-(2,5-dimethyl-1H-pyrrol-1-yl)propane-1,3-diol Serinol-pyrrole (SP)

N.B: all the experimental details for the synthesis of pyrroles have not been reported because of a patent application was filled in collaboration with Pirelli Tire S.p.A, as reported in reference 4.

alternative coupling agent

#### b) Silica-based rubber nanocomposites



**Elastomer composite recipes**  
Poly(styrene-co-butadiene) (SBR) 110 phr\*,  
poly(1,4-*cis*-isoprene) (NR) 20 phr,  
Silica 50 phr,  
TESPT 8%, SP 9%  
ZnO, S, Sulphenamide  
(\*per hundred rubber)

	Silica/TESPT	Silica/SP
E' 10 °C	7.83	9.86
E' 23 °C	5.86	7.13
E' 70 °C	4.35	5.15
(Tan delta) <sub>10°C</sub>	0.58	0.61
(Tan delta) <sub>23°C</sub>	0.34	0.38
(Tan delta) <sub>70°C</sub>	0.10	0.11

### Conclusions

- Two steps-one pot process for the conversion of 2,5-dimethylfuran to pyrrole compounds with almost null E- factor was achieved;
- 2,5-hexanedione was synthesized in yield up to 90% and the pyrrole compounds with a global yield of about 80% by using various primary amines;
- Serinol Pyrrole behaves as an efficient coupling agent for silica and can be used in place of TESPT in elastomer composites for tyres;
- In the whole process, from reagents to the Silica/SP adduct, the only co-product is H<sub>2</sub>O.

#### References:

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- Italian Patent Application n. 102021000032138, inventors: V. Barbera, M. Galimberti, L. Giannini, S. Naddeo

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