

## MANIPULATING POLYSILOXANE SURFACES USING NATURE'S POLYMERS

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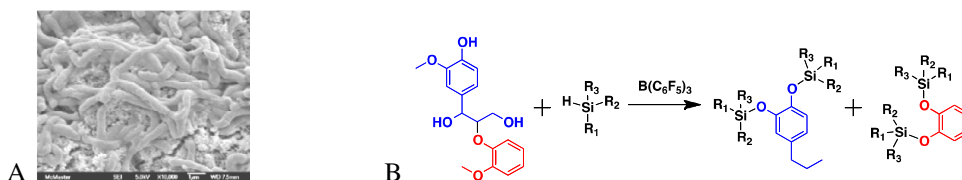
### ABSTRACT

Silicon-based materials, including silica and silicones, are widely exploited for their ability to control interfaces. With the exception of coating cellulose-based paper by silicones for release applications (e.g., label backings), however, little work has been done examining the potential benefits of incorporating renewable, natural polymers into siloxane formulations. In this talk, three different case studies will be presented, in which siloxane/biopolymer interfaces (starch, proteins, or lignin, respectively) are controlled to give composite materials.

Amorphous silica is widely used as a reinforcing agent, chromatographic support, and drug delivery vehicle, among a myriad of other applications. We now show that controlled porosity silica is readily available by the incorporation of starch as a structural support during sol-gel silica fabrication from diglycerylsilane. Three materials present in the resulting product: amorphous silica, starch, and a composite of the two at the interface. Selective digestion of the starch using amylase allows control of the porosity of the amorphous silica (Fig. 1A).

Silicone elastomers are widely used in biomaterials' applications because of their generally high biocompatibility, tunable properties and the ability to create complex structures. All biomaterials fail to some degree, often at the interface. Silicone elastomers are hydrophobic and free of functional groups. We will discuss a suite of processes that allow the surface to be functionalized with polar groups, including binding of heparin and proteins to the surface via NHS,<sup>1</sup> tosylates and click chemistry (azides/alkynes) to improve their performance in selected biological environments.

Lignin is an abundant thermoset organic polymer responsible for the structural integrity of many plants, particularly trees. The polymer is extremely difficult to process and, with few exceptions (e.g., vanilla extract), the material is burned for energy to facilitate the pulp and paper process. B(C<sub>6</sub>F<sub>5</sub>)<sub>3</sub>-catalyzed reduction of phenols and methoxybenzene groups with hydrosilanes is a facile process that leads to organosoluble phenoxysilanes (Fig. 1B). This process can be used to surface modify lignin, a polyphenol. At low levels of reduction, the integrity of the lignin is maintained, and the silylated polymer surface will reinforce silicone elastomers and, possibly, other polymers. Its advantages include lighter weight than fibreglass and a legitimate 'green' benefit. At higher levels of reduction, small molecules can be produced from this 'biorefinery' process.



**Fig. 1: A: micrograph of silica/starch composites. B: Reductive silylation of model lignin structures**

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### References:

<sup>1</sup> Chen, H.; Brook, M. A.; Sheardown, H. D.; Chen, Y.; Klenkler, B., *Bioconjugate Chem.* **2006**, *17*, 21-28.