



More Sustainable Silicones from Telechelics plus Natural Crosslinkers?

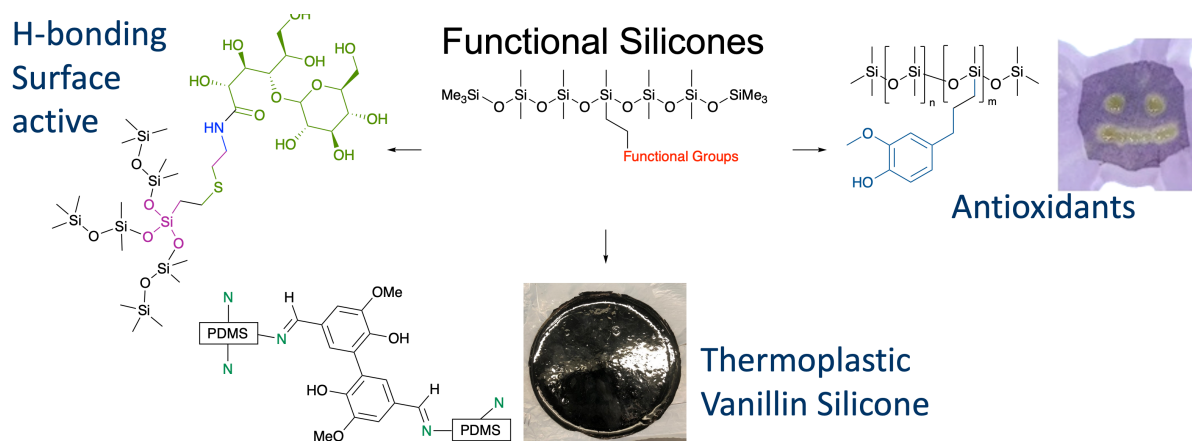
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Silicone polymers are mostly known for what they don't do: degrade under high voltage, in UV light, high temperature, biological conditions, etc. We would like to design them to efficiently degrade – at end of life – into benign materials. Dimethylsilicone oils have a rather encouraging ability to decompose in the environment. With the right conditions, depolymerization of the oils can occur in as little as a few weeks, while complete conversion to CO₂, H₂O and SiO₂ requires a few years; little is known about the efficiency of elastomer degradation. Our hypothesis is that silicone elastomers can be encouraged to more readily degrade by combining traditional telechelic (α,ω -modified) silicone oils with natural crosslinkers; once the crosslink degrades, the oils will degrade following well established pathways.

The ability to incorporate natural materials onto commercially available VinylSi, HSi, thio- and amino-modified silicones will be reported using hydrosilylation and thiol-ene, aza- and thia-Michael reactions on acrylates^[1], lactone or disulfide ring opening and redox chemistry (disulfides). The products may crosslink through normal or dynamic covalent bonds, or via ionic or H-bonding; frequently, catalysts are not required.

Some of the natural materials that will be described include: eugenol,^[2] pyrogallol and tannic acid, all of which introduce antioxidant activity; saccharides that create transient networks under stress;^[3] amino acids and proteins that can be degraded using, for example, enzymes. In some cases, it is possible to construct silicone elastomers or hydrogels that are more than 60wt% natural materials. Such compounds do not, by design, possess the normal resilience of silicone elastomers that can survive high temperatures, or oxidizing environments. This concept – adapting the nature silicones to the needs they must fulfil – will be examined.



References

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