2015 GREEN CHEMISTRY GOVERNOR'S AWARD WINNER

Mayaterials, Inc.
Tailored Silicas and Silicon Based Chemicals

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Liquid Silica from Bio- and Industrial Waste, Sustainable and Green

"Transforming ag-waste into value added products"


Richard Laine (CEO and CTO)

Mayaterials has learned to depolymerize silica at < 200 degrees Celsius using more sustainable resources including rice hull ash (RHA), diatomaceous earth (DE), and others. Importantly, the researchers realized an objective explored unsuccessfully multiple times over the past 85 years satisfying one of the "grand challenges" of silicon chemistry. Mayaterials can use RHA and DE, and likely other agricultural waste to produce alkoxysilanes, especially Si(OEt)4 [TEOS], at costs estimated to be about 10 percent of TEOS currently produced (at scale).

Traditionally, most Si compounds and materials derive from metallurgical grade silicon, made by carbothermal reduction of silica, with carbon in a high temperature, capital, equipment, and energy intensive process. Likewise, precipitated SiO2 is made by stoichiometric reaction of SiO2 with Na2CO3 at 1300° Celsius forming Na2SiO3 and one mole of CO2. Na2SiO3 is treated with H2SO4 to produce one mole of Na2SO4/mole of SiO2. These processes are equipment and energy intensive, costly, and have a significant carbon footprint.

Thus, beginning in 1930, repeated attempts were made to develop low temperature, low cost methods of depolymerizing SiO2 to generate alternate routes to Si compounds as well as precipitated SiO2. The success of such a process can be considered a "grand challenge" for silicon chemists. Researchers at Mayaterials working with researchers at the University of Michigan have now succeeded in effecting such a reaction. The Mayaterials process claims to be more sustainable and have a very low carbon footprint.

The Mayaterials process eliminates all high temperature steps, CO2 production, and uses Ag-waste or DE as sustainable, green starting materials. The discovery of several routes to effecting this reaction may provide a paradigm shift in silicon chemistry given that we can avoid energy and equipment intensive carbothermal reduction as well as the intermediacy of corrosive, toxic and polluting chlorosilanes and HCl.

Additionally, the base is recycled, and the process completely escapes producing metallurgical grade silicon. The intent is to completely supplant production of TEOS from metallurgical grade silicon by using RHA, DE, or other agricultural wastes at costs that allow them to compete in the market and move to high purity precipitated SiO2 for electronic and optical products applications.

Mayaterials plans to scale the process to a sub-pilot plant in Michigan to 50-100 kg TEOS per week and explore using Michigan agricultural waste sources. If scale up is successful, the process will change the way high purity alkoxysilanes and precipitated and fumed silica are produced worldwide, because there are multiple sources of biogenic silicas everywhere.

If Mayaterials can greatly reduce the cost of producing TEOS and related products, then the opportunity exists to also produce lower cost but higher quality precipitated silica for applications ranging from food grade silica for toothpaste for example to precipitated silicas for use as extenders and fillers for polymers including for example lower cost, lighter weight tires.