Editorial corner – a personal view

Water glass – an alternative precursor for sol-gel derived silica nanofiller in polymer composites?

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Nowadays silica containing polymer nanocomposites are preferentially produced by the sol-gel route. This implies the conversion of suitable precursors, notably alkoxysilane derivatives, to silica nanoparticles through subsequent hydrolysis and polycondensation reactions. This organosilane based sol-gel chemistry is widely practiced to produce nanoscale dispersed silica particles in thermoplastics, thermoset resins and rubbers.

Unlike using preformed silica nanoparticles as fillers, their in situ generation via this bottom-up sol-gel synthesis is not associated with health risk. On the other hand, this is quite costly procedure as the alkoxysilane precursors are highly priced fine chemicals.

Is there any chance to use a cheaper precursor? Possibly, yes, one potential candidate is namely water glass. Water glass is the common name for water soluble silicate compounds which have been known and used for centuries. The alkaline and neutral solutions of water glass products are stable. In acidic solution, however, the different alkali silicates form (poly)silicic acids which may undergo polycondensation resulting in silica nanoparticles. Accordingly, the ‘roasting’, ‘silicification’ of water glass follow a sol-gel scheme and may result in the desired nanoscale silica. This has been explored already for some polymer nanocomposites, such as polyethylene (DOI: [10.1002/polb.10391](https://doi.org/10.1002/polb.10391)), polymethyl methacrylate (DOI: [10.1002/pat.1226](https://doi.org/10.1002/pat.1226)) and phenolic resin (DOI: [10.1002/app.29770](https://doi.org/10.1002/app.29770)). Organosilane may be dosed additionally to improve the interfacial adhesion between the matrix (polyamide) and the silica (DOI: [10.1002/pi.1520](https://doi.org/10.1002/pi.1520)).

Water glass can be turned into silica particles whereby avoiding the (poly)silicic acid formation. This may happen upon reaction of water glass with carbon dioxide which can be formed also in situ, for example through the reaction between isocyanate and water. This reaction is exploited in various polyurea-based thermosets produced from polyisocyanate/water glass combinations in presence of suitable emulsifiers which may be coreactive compounds, as well (DOI: [10.1016/j.eurpolymj.2007.01.010](https://doi.org/10.1016/j.eurpolymj.2007.01.010); DOI [10.1007/s10853-009-4145-9](https://doi.org/10.1007/s10853-009-4145-9)). Note that the inevitable byproducts of this chemical pathway are inorganic carbonates.

Polymer nanocomposites are often referred to as inorganic/organic systems. Though water glass is a rather complex, not well defined system, it may meet the role of silica precursor in several applications. One just has to acquire the necessary knowledge from inorganic chemists and learn how to make use of water glass for this purpose. Trials with water glass may open a new horizon for the production of polymer nanocomposites, and especially for thermoset resin-based ones. So, why not to start with exploratory experiments?

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