Silicon polyolates: Opportunities and challenges in materials synthesis

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Organic silicon compounds are the key precursors in the synthesis of siloxane- or silica-based materials, like e.g. silicones, glasses or hybrid materials. Most frequently, alkoxysilanes based on monofunctional alcohols, such as $Si(OR)_4$ or $R'Si(OR)_3$ with R = CH_3 or C_2H_5 are used as starting compounds. Silicon polyolates, which can be obtained either from tetraalkoxy-/ organotrialkoxysilanes or from biogenic amorphous silica with the corresponding polyols, have already been studied for many years. However they are still not very common in materials synthesis.

In this lecture, an overview of the rich diversity of the polyolate chemistry of silicon will be presented. Not only the structure and chemistry of these modified silanes, like e.g. tetrakis(2-hydroxyethyl)orthosilicate, bis(catecholato)silane or analogous carbohydrate derivatives will be highlighted, but also the differences in reactivity, e.g. hydrolysis and condensation reactions, in comparison to tetraethoxy- or methoxysilane will be discussed. However, these silanes offer far more interesting aspects, such as their role in diol or polyol-mediated de-polymerization reactions of (biogenic) silica towards a more sustainable route to $Si(OR)_4$ or silica materials. In addition, utilizing diol- or polyol-based precursors in materials synthesis leads to novel opportunities regarding templated structures or processing strategies, e.g. 3D printing or melt-based syntheses.[1-7]

References

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