Hamburg University of Technology (TUHH)
Institute of Thermal Separation Processes -V8-
Eissendorfer Str. 38, DE-21073 Hamburg

Please fill out the form with the corresponding data for your abstract and send it to: aerogelconference@tuhh.de

In the E-mail you may include other files (e.g. Word, PDF or images).

Abstract Formulary

Presentation type: **Oral** ✔ **Poster** ☐

Title: Enhancing flexible hybrid silica aerogels: integrating new functionality through addition of different precursors

Authors: Danny Bialuschewski, Kai Steffens, Emrah Okumus, Adam Dzierbinski, Pascal Voepel, Barbara Milow

Presenting author: Danny Bialuschewski

Institution (Presenter): Institute of Inorganic Chemistry, Nanostructured Cellular Materials, University of Cologne, 50939 Cologne, Germany

ABSTRACT (Space limited to 2200 characters)

Hybrid silica aerogels can overcome one of the main drawbacks of classical silica aerogels, which are unsuitable for many industrial applications due to their brittle network. By modifying the synthesis through changes in the sol-gel, drying or post-treatment processes, properties like the mechanical flexibility of aerogels can be enhanced. This was done by Hayase in 2011 through addition of one or two methyl-groups to the tetravalent Si-precursors, resulting in flexible silica aerogels, known as “marshmallows”.

On the basis of our previous research, we modified the synthesis, washing or post-treatment steps to introduce changes on a chemical or physical level. For this, we went from Hayase's binary precursor system consisting of methyltrimethoxysilane (MTMS) and dimethyldimethoxysilane (DMDMS) to a ternary one by adding or partially substituting with another precursors. This was investigated with tetraethoxysilane (TEOS), often used for classical silica aerogels, with the goal reduce the pore sizes, leading to improved thermal and acoustic insulation behaviour. This comes at the expense of flexibility, where a minimum still needs to be maintained.

Another precursor with potential for functionalization is vinylmethyldimethoxysilane (VMDMS). Using it for up to 20% of the total silane-precursors resulted in soft and flexible aerogels, with higher contents leading to more brittle or outright no monolithic material at all. The vinyl-groups allow the binding of additional molecules through radical polymerisation, investigated by adding vinylphosphonic acid (VPA). VPA is a promising candidate as flame retardant, as phosphorus forms a protective coating during thermal decomposition. This is an important property lacking in the basic marshmallow aerogel, which completely burns up once inflamed due to its high carbon content. Similarly, other flame retardants can physically combine with the basic marshmallow, either by coating or infiltration post-gelation.

This work was performed under the project “Labkabin” (funding number 20Q1908C) as part of the joint project “Multikabin”, funded by the Federal Ministry for Economic Affairs and Climate Action (BMWi).