**Formation of Amorphous Silicon Nitride Nanoparticles from the Gas-Phase – Transfer from the Lab to a Pilot Scale Reactor**

*Moritz Loewenich1, Atharva Ladole1, Hartmut Wiggers1,2
1 EMPI-RF, Universität Duisburg-Essen, Duisburg – Germany
2 CENIDE, Universität Duisburg-Essen, Duisburg-Germany*

*Corresponding Author: moritz.loewenich@uni-due.de*

Lithium-ion batteries can be an important asset in the transformation to a sustainable society. Here high-capacity storage materials are needed to improve overall energy density, to enable the use of Li-ion batteries for more applications and to decrease the overall costs per kWh. Silicon-based materials offer these benefits, yet the cycling stability is still an unresolved issue. Ways to improve cycling stability are the use of nano silicon and the production of silicon-based, nanoscale alloys to reduce parasitic effects during the charging/discharging process. Especially, silicon nitride offers specific advantages during battery operation as a conversion type material.

With the gas phase synthesis of amorphous, substoichiometric silicon nitride nanoparticles, both approaches for improvement can be combined. The respective materials can be produced in a hot-wall reactor (or free-space reactor) by the co-pyrolysis of monosilane and ammonia. In this work we compare previous experiments in a lab-scale reactor [1] with results from a pilot reactor that can produce on the kg/h scale [2]. Temperatures, flow conditions and gas-concentrations are varied to study the impact on the product powder characteristics such as composition, elemental distribution, and particle morphology. More information on the gas phase reactions are obtained via off-gas analysis. Furthermore, the composition of the sheath gas was varied with respect to its thermal conductivity in order to influence the material properties via temperature gradients in the synthesis volume. Through process optimization, it has been possible to produce suitable materials over a wide parameter range, which is confirmed by electrochemical investigations.

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Literature:

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