GEMS
German Engineering Materials Science Centre

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Case Study

Investigation of agglomeration of nanoparticles in polymer resins

New materials with multiple applications

The company Evonik Hanse GmbH (former Nanoresins) from Germany has specialized in embedding nanoparticles into polymer matrices. Knowledge about the agglomeration behaviour of nanoparticles during the production process of nanocomposites is very important because agglomerates can significantly degrade the properties of this new class of materials.

Figure 1: applications of nanoparticle polymer composites

SiO_2 nanoparticles are used, e.g., in electric components or in coatings for surface protection in automobile and data storage industry, where they can significantly improve properties like, e.g., abrasion resistance, thermal conductivity or optical clarity.

Figure 2: Embedding of Nanoparticles into a polymer resin

Small angle neutron scattering (SANS) is a valuable, nondestructive method to investigate the amount and size of aggregations of nanoparticles in solution as well as in polymer matrices. Therefore, the monodisperse SiO_2 nanoparticles could be investigated before their transfer from aqueous sodium silicate solution into polymer or epoxy resin matrix and afterwards.

By SANS measurements, **Evonik Hanse GmbH** was able to prove, that the narrow size distribution of the nanoparticles was preserved during the transfer from aqueous to polymer matrix. On the basis of this results, Evonik Hanse GmbH was able to apply for a patent for this special production process.[1]

1. W. Reimers (editor), A. R. Pyzalla (editor), A. K. Schreyer (editor), H. Clemens (editor,) Neutrons and Synchrotron Radiation in Engineering Materials Science, Viley VCH, **2008**, p. 245.

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Solving materials problems

With X-rays or neutrons

The German Engineering Materials Science Centre (GEMS) is a central user access platform, where the Helmholtz-Zentrum Geesthacht provides a worldwide unique infrastructure for complementary research with photons and neutrons. Instruments using synchrotron radiation are operated at the outstation at DESY in Hamburg, instruments using neutrons are located at the outstation at the FRM II Garching, near Munich.

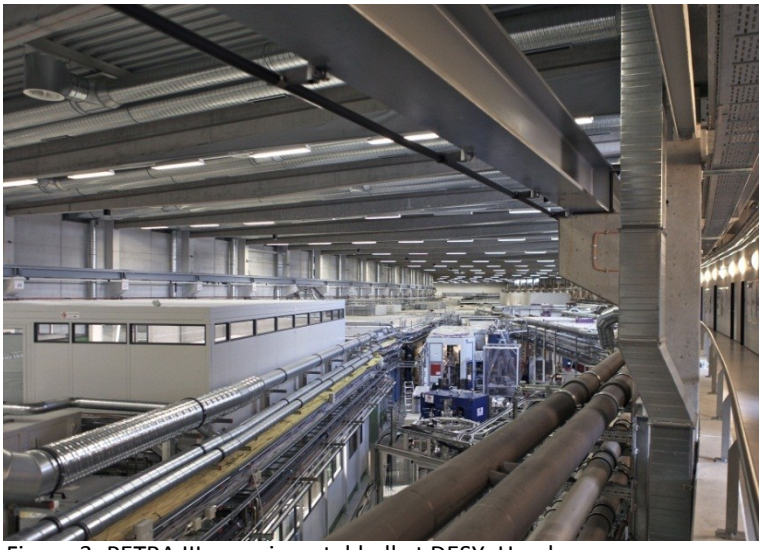

Figure 3: PETRA III experimental hall at DESY, Hamburg

Figure 4: Experimental hall at FRM II in Garching, near Munich

GEMS provides you with state of the art materials analysis well beyond the capabilities of standard laboratory equipment:

- 3-D imaging (radiography, tomography)
- Residual stress measurements
- Analysis of phase transformations
- Characterisation of nanostructured hard and soft matter samples

Industry specific user support:

- Materials science support labs (sample preparation and characterisation)
- data analysis, secrecy agreements
- In situ sample Environments:
  - Furnaces
  - Cooling devices
  - Stress rigs
  - Dilatometer
  - Laser and friction stir welding devices

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