Success Story
COMET

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imPACts
Industrial Methods for Process Analytical Chemistry

ImPACts
Industrial Methods for Process Analytical Chemistry - From Measurement Technologies to Information Systems
Programme: COMET – Competence Centers for Excellent Technologies
Programme line: K-Projects
COMET subproject, duration and type of project:
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Levitated viscosity sensing – compact & in line

Inline-monitoring plays a major role in modern biochemical production processes. A large number of sensors monitor the state of the production process continuously. Complex mathematical models are used to predict the quality of the final product and allow an active control of the production process. Every single sensor in the system helps to improve the prediction quality of the model. A very important fluid property for chemical processes is the viscosity, which in many cases allows directly concluding to the progress of the production process.

Viscosity-sensors

The Institute for Microelectronics and Microsensors at the Johannes Kepler University Linz performs research on sensors for various physical properties. Besides optical, thermal and biochemical sensors also viscosity-sensors are investigated. Viscosity is a measure for the resistance of a fluid against flow and thus affects its flow behavior. Many of the investigated sensors utilize the principle of resonant micro sensors. Here, mechanically oscillating structures are immersed into the viscous fluid to be tested. Due to the interaction with the fluid, the oscillations are damped, where a higher viscosity leads to a stronger damping. Therefore it is possible to calculate the viscosity from the measured damping.

From the idea to the prototype

During the project Process Analytical Chemistry Projekt (PAC), a so called “Levitating Sphere Viscometer” was developed and patented. The system is based on a freely levitating permanent magnet (floater magnet) which is electromagnetically excited to perform mechanical oscillations (see Fig 1). In the current project “K-Projekt imPACts” the idea was refined and a working demonstrator was build. The advantages of this special sensor system are the entirely spatial isolation of the measurement chamber from all actuation or readout systems and the high number of different oscillation or motional modes which can be used for measurements. During the measurement only the floater magnet and the measurement chamber are in contact with the fluid. No mechanical or electrical connections into the measurement chamber are necessary. This makes the system especially interesting for toxic, corrosive or sterile fluids.

Due to the flexible electromagnetic actuation, various different movements of the measurement body can be excited. Linear movements along the vertical axis and also rotational oscillations along the horizontal axis are feasible. Furthermore it is possible to bring the floater magnet into a rotational motion around the vertical axis. Each vibration mode yields certain

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measurement characteristics that can be utilized to gain more detailed insights.

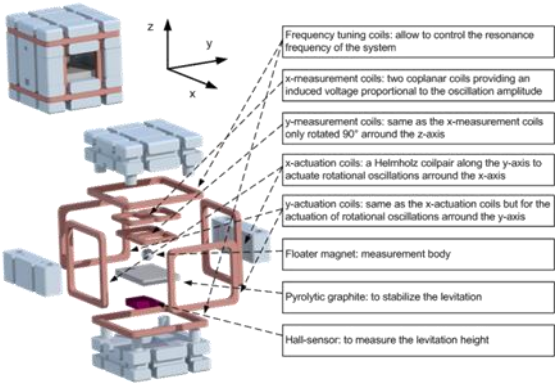

Fig. 1: Detailed view of the measurement chamber containing all actuation and readout coils.

The actuated oscillations are damped by the fluid in the measurement chamber, which allows calculating the viscosity. To do so, first the frequency response of the system is measured performing a frequency sweep near the resonance frequency (see Fig 2). In a second step the quality factor of the resonance is calculated. This factor is related to the viscosity of the fluid.

Cooperations

For the research on sensors it is essential to have access to the experience and the knowledge of the industry that will potentially apply the investigated device or system. The network of company partners in imPACts covers a large spectrum of different branches in the chemical and biochemical sector. Close collaboration with different company partners allow to consider their requirements already during the ongoing research and in the design phase.

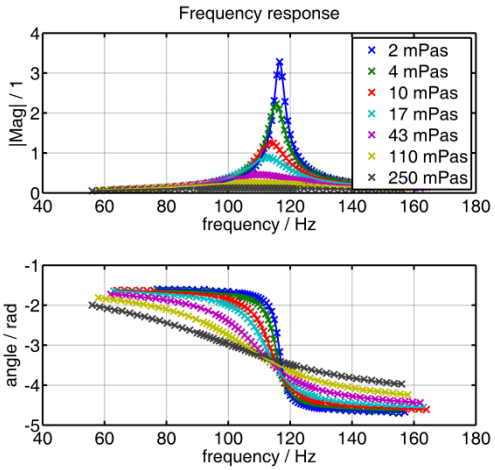

Fig. 2: Frequency response of the system while performing rotatory oscillations in different viscous fluids.

Impact and effects

Due to the improvement of sensors and the integration of inline-viscosity sensors in chemical and biochemical production processes, it becomes possible to improve and optimize process control systems. This leads to increased quality and output combined with reduced production costs.

The results of the sensor development achieved within the imPACts project were published in peer-reviewed international scientific journals.

Contact and information
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Lenzing AG	Austria
DPx Fine Chemicals Austria GmbH & Co KG	Austria
Sandoz GmbH	Austria