Acoustic detection of thin films in fluid-filled hoses and pipes

Reference No: B69127, B77157

CHALLENGE

The propagation of surface acoustic waves along the surface of a substrate is very sensitive, in both its amplitude and velocity, to any deposition on the surface. Their miniaturized design, high thermal stability, and possibility of wireless integration make surface acoustic wave sensors very promising devices for Internet of Things applications. Specifically, in the context of **industrial automation** the **continuous monitoring of the infrastructure** becomes absolutely crucial. The continuous monitoring enables targeted and **predictive maintenance measures,** which promise significant cost reductions compared to time-based preventive maintenance and failure-based corrective maintenance. A significant problem in a wide range of industrial applications, such as in the chemical, medical, and process industries, is the **deposition of thin films on the inside of hoses and pipes conducting fluids.**

INNOVATION

The inventors suggest a method and device, based on **Lamb-wave propagation** along solid walls[1]. Exploiting this approach, the piezoelectric sensor elements can be **mounted on the outside of liquid filled conduits** made from any structural material, i.e. glass, plastics, and metal. This allows for **non-invasive measurement of thin films**[2] with a **sensitivity down well below 100 µm.** The inventors have suggested a number of ways that enable **easy retrofitting of existing conduits** for these measurements, including measurement collars for flexible hoses with soft walls and clamp-on devices for solid pipes with circular cross sections.

COMMERCIAL OPPORTUNITIES

Use cases include the **detection and thickness monitoring of deposition layers** in a fluid-filled conduit, such as **biofilm, limescale, and polymer layers.** Enabling a wide variety of industrial applications, as well as applications in supply engineering and medical devices, e.g. catheters. Additionally, the invention also allows for **monitoring of conduit properties,** such as embrittlement, and measurements of the filling level in partially filled horizontal pipes.

DEVELOPMENT STATUS

Functional demonstration with growing biofilms.

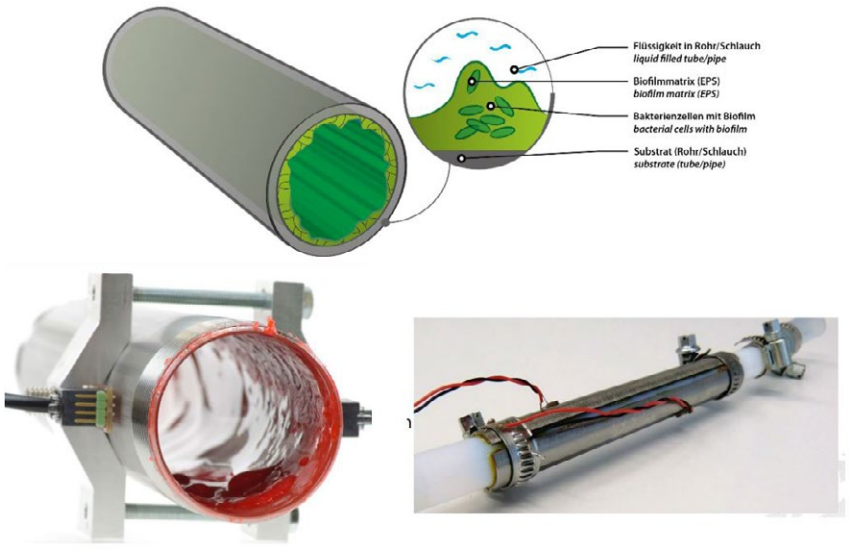

Figure: A thin biofilm deposited inside a fluid-filled conduit (top). Photo of the experimental setup for a clamp-on device[2] (bottom left). Photo of the experimental setup for a collar-based measurement device for soft hoses (bottom right).

REFERENCES:

1. G. Lindner, J. Phys. D: Appl. Phys., 41, 123002 (2008); doi: 10.1088/0022-3727/41/12/123002
2. S. Tietze et al., Sensors 2018, 18(2), 526 (2018); doi: 10.3390/s18020526

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Technology from
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