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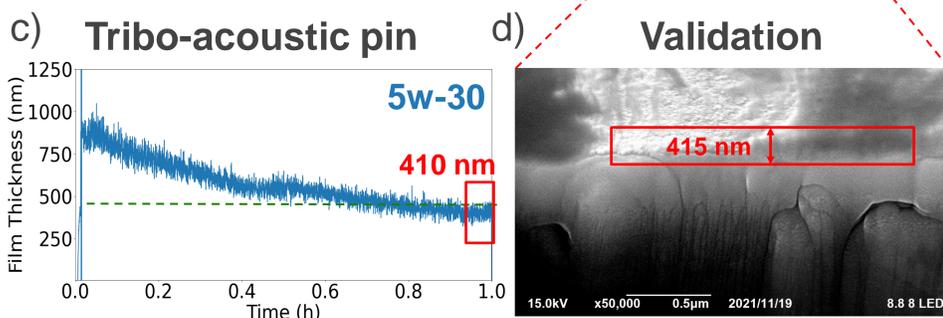
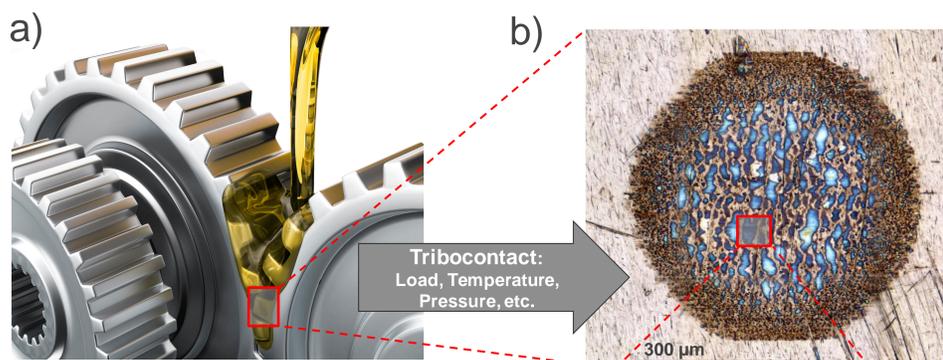
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Introduction and Goal

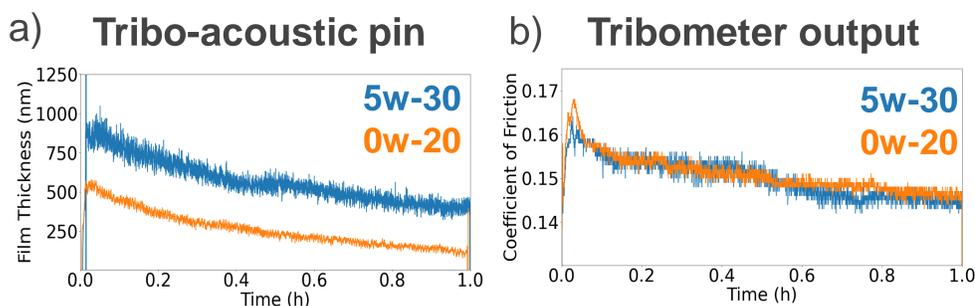
- The European Ecolabel aims to achieve the European Green Deal climate goals by **cutting harmful emission by 55%. Over 23% of world's energy is lost through friction**, thus a balance between "green" oil formulation and its performance needs to be achieved.
- By this standard, **oils must be made from at least 32.5% renewable resources**. Thereto, green lubricants are a major step towards reaching the European Green Deal.
- To optimize the lubricant's frictional performance, **tribological testing plays a crucial role**. We developed a new sensor for tribo-testing called the **tribo-acoustic pin**. This sensor looks like a standard test pin, but it is a complex laboratory in a chip that measures oil performance in real time and non-invasively!
- Our goal is to provide **tribo-testing platforms worldwide** with this next generation of tribological sensing device.

Results & Discussion

- Oil film thickness is measured via the tribo-acoustic pin **continuously in real time and non-invasively** throughout the experiment.
- The measured thickness over time **agrees with theoretical models** and the optical analysis of the tribofilm.
- The possibility to measure film thickness in real time provides **crucial information about the performance** of a lubricant. With this tribo-acoustic pin, green lubricants can be evaluated in real time.
- Green lubricants improved to provide optimal lubrication in respect of **international regulations and SDGs 11, 12 and 13**.



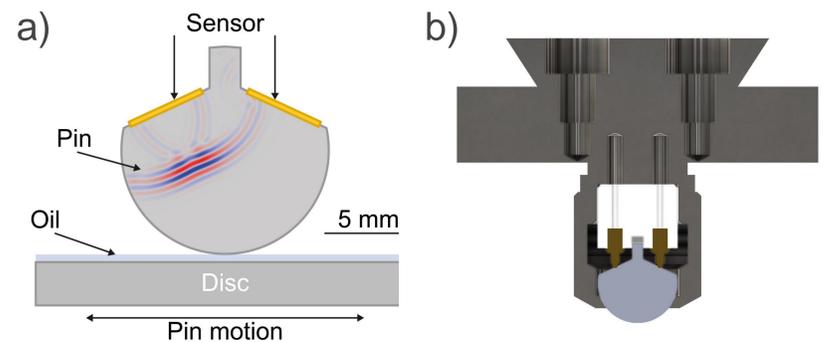
(a) Additivated oil forms solid tribofilms on the rubbing surfaces, as simulated in (b) the tribological model test. (c) our new technology measures the thickness evolution over time of such films. The measurement was validated with (d) scanning electron microscopy showing identical film thickness at the end of the experiment.



(a) Film thickness measurement using the tribo-acoustic pin versus (b) coefficient of friction measured for 2 oils. The tribo-acoustic pin measurement is capable of showing the difference between the two oils clearly.

Methodology and Implementation

- In standard tribological testing, the real contact situation of a machine component is modelled by a spherical pin rubbing on a counter body. A lubricating oil is interleaved between the two bodies, thus **recreating a model of the real contact**.
- A tribo-acoustic pin consists of a spherical pin instrumented with ultrasonic sensors and uses high frequency ultrasonic waves to measure the oil in the contact non-invasively and in real time. **Connection is done wireless**, thus being easy to use.
- This **non-invasive** sensor allows monitoring of the **oil film thickness** during the experiment, being the most **crucial performance parameter** in lubricated contact.
- Conducted experiments aim at the reduction of frictional losses and thereby cut of harmful emissions.



(a) Working principle of the tribo-acoustic pin with the ultrasonic wave propagating toward the tribological contact. (b) Schematics of the sensor assembled in a standard test holder.

Business Potential

- Technology **IP registered!**
- Over 1,000,000 tribotests/year** are performed worldwide.
- Tests are time consuming, and it is crucial to:
 - ▲ Maximize information gained.
 - ▲ Assess test performance and reduce false positive results.
 - ▲ Improve decision making and reduce number of tests and time.
- The tribo-acoustic pin is:
 - ▲ **Easy to use.**
 - ▲ **Cheap** – it costs barely more than a non-instrumented pin.
 - ▲ **Customizable** for any tribometer and customer.



Product line of the tribo-acoustic pin. This wireless sensor can be adapted to any commercially available tribometer.

Conclusions

- The next generation of tribotesting sensor, the **tribo-acoustic pin**, has been developed, validated and the IP was registered.
- The sensor measure **non-invasively and in real-time** the lubricant performance in standard tribological test rigs.
- The direct measurement of tribological properties will allow timely **development of green lubricants** and provide a method to **optimize the performance** of green lubricants.

Literature

M. Schirru, F. Tatzgern, M. Varga, A. Pauschitz: Vorrichtung zur Bestimmung chemisch-physikalischer Eigenschaften in einem tribologischen System, Patent number A 50205/2021.

Acknowledgement

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