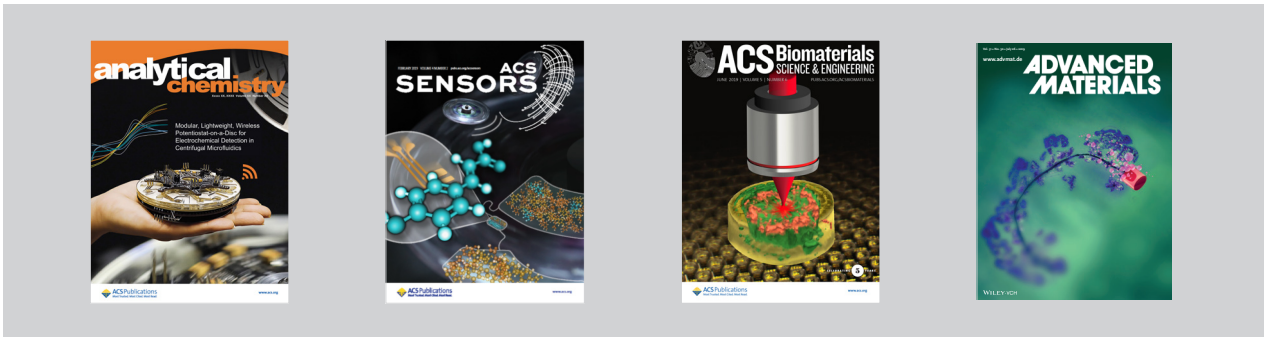
## Annual Highlights

The IDUN research activities in 2019 have resulted in 38 peer reviewed journal articles, 56 conference contributions and 31 invited talks. Four of our 2019 papers have impact factors above 10 (Nature Com, Adv. Materials, ACS Nano and Adv. Drug delivery rev). 50 people were in 2019 working in relation to the IDUN center and together they supervised 35 Master students and taught several courses. We successfully ran our PhD summer school program for the fourth time, with a track on drug delivery and one on micro- and nano-sensors, and hosted our annual "IDUN Industry Day" for our 20 invited members from industry.

In 2019, Anja Boisen was awarded her third ERC PoC grant for work in therapeutic drug monitoring. Sarvesh Srivastava was awarded both a DTU PoC grant and a Lundbeck Experiment grant for research in oral delivery of Insulin and magnetically-guided microbots respectively. Chengfang Pang received a Villum experiment grant with a project on nanoparticle-Microbial Interactions in antimicrobial resistance. Senior researcher Tomas Rindzevicius was granted funding for a H2020 framework project on chemical threat detection. In addition, Anja Boisen is a collaborator on three recently granted research projects within pediatric cancer (Rigshospitalet), oral vaccine delivery (SII) and healthy aging (Hvidovre Hospital). Ritika Singh Petersen has started an industrial postdoc with FOM technologies on work initiated by IDUN research. IDUN PhDs and postdocs took home 146.273 kr. in travel grants.

Lastly, IDUN was prolonged for a second research period after our midterm evaluation in 2019. The entire center has been actively involved in the work leading up to our site visit in September. We are all beyond excited for the positive review and for the opportunity to take our research to the next level.




### IDUN Drug

When using microcontainers and permeation enhancers, insulin can be transported across cell layers as well as tissue. The containers are essential - probably because they provide a local co-localization of drug and permeation enhancers. However, an exponential decrease in insulin transport is seen with increasing distance between microcontainers and the intestinal wall. To ensure closer contact, new designs of drug delivery devices are being developed. Our first microcontainer results on oral vaccine delivery show that a vaccine can be formulated, loaded and protected by a pH sensitive lid and delivered to mice. Indications of an immunological response is seen after a subcutaneous booster. A method for realization of devices in biodegradable materials has been developed and new applications in the fields of antibiotics/probiotics delivery are showing first promising results. Microdevices have been 'repurposed' for the use as microbots that can self-propel and collect cell samples along their trajectory.

### IDUN Sensor

We have discovered a method to make Surface Enhanced Raman Scattering (SERS) substrates more selective and reusable. We integrate the SERS substrate with potential control whereby it is possible to attract and repel molecules. This will be a unique tool in our future work towards therapeutic drug monitoring. Our recent development of a Single Acquisition Raman Orientation Mapping (SAROM) tool has facilitated a breakthrough in monitoring of e.g. crystal orientation in drug formulations and will form the basis for a spinout company. Using single crystals as resonators, we have been able to unravel thermal properties of single drug crystals. Sensor integration with centrifugal microfluidics has facilitated easy cell culturing/monitoring.