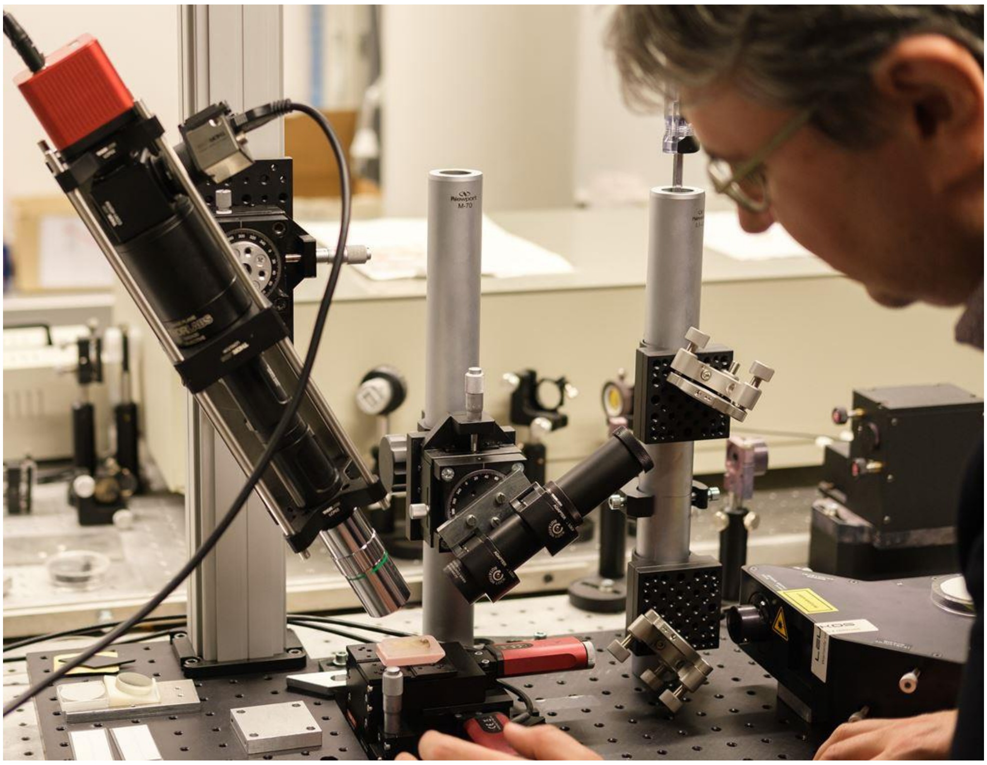
ATTRACT phase 2

Developing breakthrough technologies
for science and society

MetaHiLight project*

MetaHiLight aims to improve cancer diagnostics by using invisible properties of light combined with artificial intelligence. By including micro- and nanotechnology from SINTEF and the University of Southern Denmark and a novel diagnostic technique from the University of Oulu, the goal is to make a compact and robust system for detection of cancer in tissue samples. Our hope is that this in the future can be placed in hospitals or doctor's offices and only require little training before use.



Microscope setup. Photo: Paul V. Thrane/SINTEF

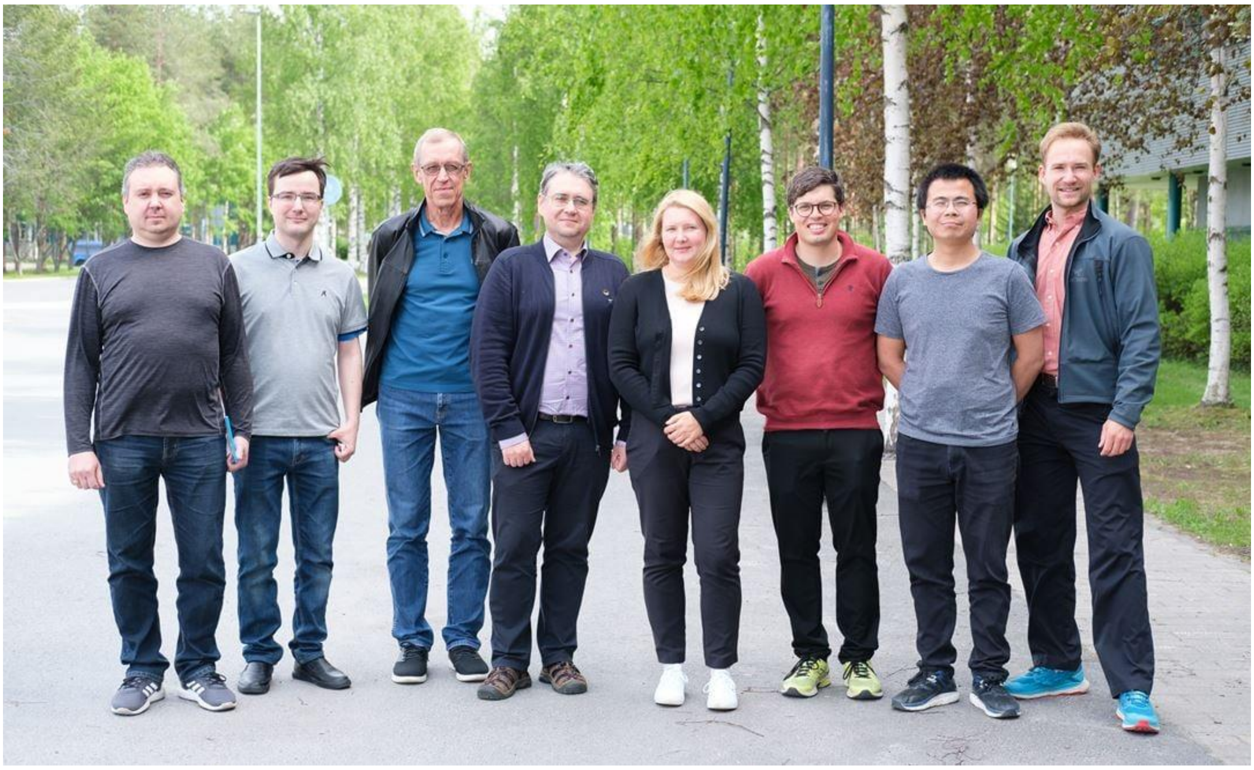
Detection of cancer in tissue currently consumes considerable time and resources. After tissue samples are taken from the patient, the samples need to be carefully prepared for examination under the microscope by specialists. The tissue samples for instance have to be cut very thin and stained to ease the examination by microscope. Patients who await the results of such a test therefore have to be prepared to wait for considerable time.

As an answer to these challenges SINTEF, in collaboration with the University of Oulu and the University of Southern Denmark, aim to develop a new platform for cancer diagnostics which is faster and requires less resources. By using invisible properties of light combined with artificial intelligence, we are attempting to improve cancer diagnostics.

Our research partners at the University of Oulu have developed a method where they can detect cancer by observing how light changes after being reflected from tissue samples.

More specifically they observe how the oscillation direction (polarization) of light changes when bouncing off healthy and unhealthy tissue. The method allows for thicker tissue samples than in standard diagnostics, removing the need for some tedious sample preparation. By allowing artificial intelligence to analyse the reflected light instead of a human, one also removes the need for staining the tissue sample. In this way one can also free up human resources in an overburdened healthcare system.

The contribution of SINTEF and the University of Southern Denmark in the project is to develop novel optical components based on nano structured surfaces (metasurfaces) and Micro-Electro-Mechanical-Systems (MEMS) which allow us to miniaturize the system. Our goal is that this will contribute towards making the system easier to mass-produce and make available in doctors offices and developing countries.



Group photo at kick-off meeting in Oulu June 2022. From the left: Olexii Siery, Ivan Lopushenko, Sergey I. Bozhevolnyi, Alexander Bykov, Karolina Milenko, Christopher Dirdal, Chao Meng, and Paul Thrane.

Relevant publications:

- Chao Meng, Paul C. V. Thrane, Fei Ding & Sergey I. Bozhevolnyi
  Full-range birefringence control with piezoelectric MEMS-based metasurfaces. Nature Communications 13, 2071 (2022). https://doi.org/10.1038/s41467-022-29798-0

- Chao Meng, Paul C. V. Thrane, Fei Ding, Jo Gjessing, Martin Thomaschewski, Cuo Wu, Christopher Dirdal, and Sergey I. Bozhevolnyi
  Dynamic piezoelectric MEMS-based optical metasurfaces. Science Advances, 7(26), eabg5639 (2021) https://doi.org/10.1126/sciadv.abg5639

- Paul C. V. Thrane, Chao Meng, Fei Ding and Sergey I. Bozhevolnyi
  MEMS Tunable Metasurfaces Based on Gap Plasmon or Fabry-Pérot Resonances. Nano Letters 22.17 (2022): 6951-957
  https://doi.org/10.1021/acs.nanolett.2c01692

- Fei Ding, Anders Pors, Yiting Chen, Vladimir A. Zenin and Sergey I. Bozhevolnyi, Beam-Size-Invariant Spectropolarimeters using gap-plasmon metasurfaces. ACS Photonics 4, 943-949 (2017) https://doi.org/10.1021/acsphotonics.6b01046

- Deyan Ivanov, Viktor Dremin, Alexander Bykov, Ekaterina Borisova, Tsanislava Genova, Alexey Popov, Razvigor Ossikovski, Tatiana Novikova, Igor Meglinski. Colon cancer detection by using Poincaré sphere and 2D polarimetric mapping of ex vivo colon samples. Journal of Biophotonics 13.8 (2020): e202000082
  https://doi.org/10.1002/jbio.202000082

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