Newsletter

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CHROMAVISION
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 665233.

INSIDE THIS NEWSLETTER

Proud Announcements

- Our core business LUMICKS is nominated in the category of "Best Young SME 2018" for the H2020 Innovation Radar Prize 2018.
- Our partner DTU has won the Innovation Radar EU prize 2018 in the "Excellent Science" category for the FET-OPEN project: CHROMAVISION.
- The prestigious "Launchpad" proposal of Prof. Anders Kristensen on "Digital Resonant Laser Printing for Mass Customization of Flat Optics" is successfully granted.

Coming Next Year: Symposium

Symposium date: **May 23, 2019**
Workshop date: **May 24, 2019**
Location: **Crick Institute at London, UK**
No registration fee

Check our website for more details!

CHROMAVISION is proudly organizing a symposium with the honorary presence of great invited speakers in the field as well as leading investigators of the CHROMAVISION, following by a demonstration workshop of the instrument developed within the CHROMAVISION project, organized by LUMICKS.

Our Latest Technological Achievement

Within the CHROMAVISION project, LUMICKS has developed a widefield chromosome imaging and manipulation platform. This platform, consisting of microfluidics, optical tweezers and single-molecule widefield imaging combined into a correlative solution, allows the imaging and manipulation of metaphase chromosomes in real-time. Using this platform, researchers will address key challenges in clinical and fundamental chromosome research, potentially resulting in breakthrough discoveries.

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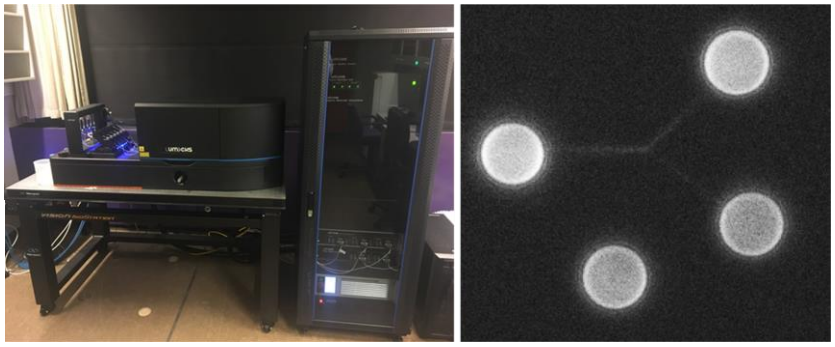

Figure 1 - **Left:** A C-Trap™ correlated tweezers fluorescence microscope equipped with widefield imaging was installed in October in the lab of Ian Hickson at the University of Copenhagen as part of the CHROMAVISION collaboration. **Right:** Preliminary data obtained from the installed C-Trap™ show two DNA molecules tethered between four optically-trapped microbeads, forming DNA knots.

Latest Papers of the CHROMAVISION Consortium

Technical University of Denmark

"Resonant laser printing of structural colors on high-index dielectric metasurfaces."
Zhu et al. (2017)
Science Advances

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VRIJE UNIVERSITEIT AMSTERDAM

"Reconstitution of anaphase DNA bridge recognition and disjunction."
Sarlós et al. (2018)
Nature Structural & Molecular Biology

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UNIVERSITY OF COPENHAGEN

"Folate deficiency drives mitotic missegregation of the human FRAXA locus."
Bjerregaard et al. (2018)
PNAS

SEE PAGE 4

Denmark Technical University

Resonant laser printing of structural colors on high-index dielectric metasurfaces

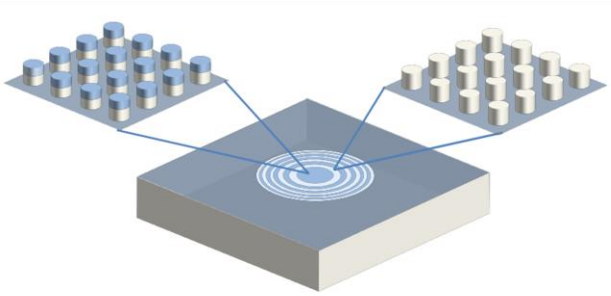
CHROMAVISION partner DTU has developed a novel technology to laser print with an ultra-high resolution of 127.000 DPI (Dots Per Inch) in both plasmonic and in high-index dielectric optical metasurfaces. These concepts were applied to demonstrate high-throughput holographic laser printing of ultra-thin optical lenses. Mass-customization (i.e. individualized properties of each copy) of ultra-thin and light-weight optical components, such as lenses, is enabled by on-demand laser-printing.

Interested in the technology?

Watch this video

or

Read the paper (Science)



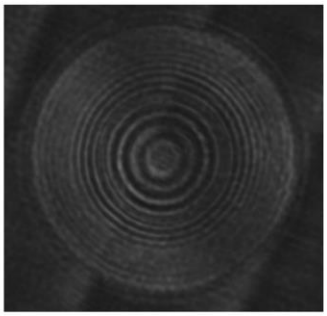


Figure 2 - Laser printed optics. Ultra-thin Fresnel Zone lenses are laser printed on nano-structured template metasurfaces. The template metasurface comprises an array of nano-scale cylinders (diameter and height around 100 nm), with a thin (approximately 100 nm) film of Silicon deposited to form isolated nano-disks on top of each cylinder. The concentric rings forming the lens, are defined by scanning the beam of a pulsed laser, to re-shape or ablate - as illustrated here - the nano-disks. The picture to the right shows a microscope image of a laser written lens.

Vrije Universiteit Amsterdam

Interdisciplinary collaboration elucidates genome repair mechanism during human cell division

Researchers from the University of Copenhagen (led by Ian Hickson) and the Vrije Universiteit Amsterdam (led by Erwin Peterman and Gijs Wuite) part of the CHROMAVISION consortium have elucidated how mitotic DNA repair proteins act during cell division in human cells. They were able to elucidate the key recruitment features of these proteins by reconstituting damaged chromosome sections. These results provide important insights into the regulation of cell division in humans and are published in the scientific journal *Nature Structural and Molecular Biology*.

Before cell division, the DNA is compacted in to chromosomes, which have to be replicated and subsequently be equally divided between the two daughter cells in human mitosis. However, it has been shown that the replication and segregation of the sister chromosomes is not always complete. Thus, the sister chromosomes are frequently still entangled during cell division and give rise to so-called ultra-fine DNA bridges (UFBS) connecting the chromosomes. In humans, it is known that four different proteins (PICH, BLM, TRR and RPA) are mainly responsible to resolve these UFBs. Failure to do so can result in loss of genetic material, mutations and eventually cancer.

Using optical tweezers, researchers produce DNA strands in a flow cell that mimic UFBs in the cell. They were able to produce and manipulate, in a controlled fashion, both double stranded (ds-) and single stranded (ss-) DNA. First they established that BLM and TRR for a tight complex (BTRR) that can bind efficiently to PICH-coated dsDNA whereas binding to bare dsDNA is much weaker. Second, they found that the presence of RPA suppresses BTRR-binding to ssDNA. This is surprising, since it is known that ssDNA constitutes the main binding target of BTRR, and the latter forms a complex with RPA in solution. Third they found evidence that this unexpected BTRR-RPA down-regulation could have been invented by nature in order to prevent “over-repair” of UFB-sections. Finally, their *in vitro* results are in full agreement with the binding pattern of the four proteins on UFBs observed *in vivo*.

The research plan in the future to elucidate this mechanism in whole purified metaphase chromosomes that are pulled apart with the instrumentation and workflow that was developed in the CHROMAVISION project.

Read the paper (Nature)

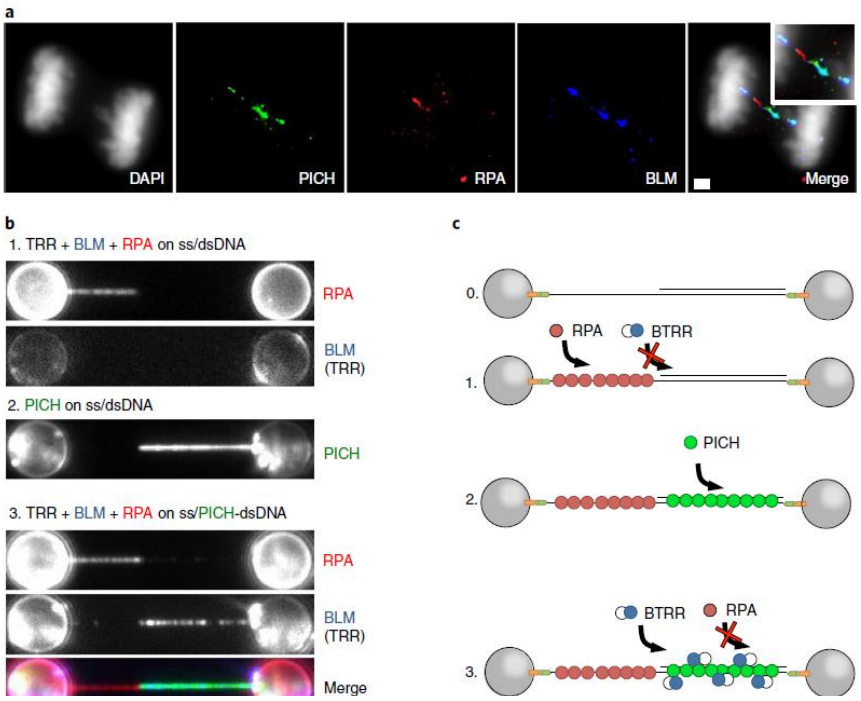


Figure 3 - Processing of fragile-site UFBs by the PICH-BTRR machinery.
a: Immunofluorescence images of anaphase U2OS cells treated with aphidicolin and displaying UFBs coated with PICH (green), RPA (red), and BLM (blue). Scale bar, 1 μ m. **b**: Use of optical tweezers to model the recruitment of BLMSNAP, TRR (not labeled), and RPAStrawberry to a partial single- and double-stranded model of an fsUFB before (1) and after (3) decorating it with PICHGFP (2). **c**: Schematic representation of the naked ssDNA and dsDNA (0) and the DNA-bound proteins (1-3) presented in b (blue, BLM; white, TRR; red, RPA; green, PICH). *The figure is taken from Sarlos et al. Nature Structure & Molecular Biology, 2018, 868-876 with permission.*

University of Copenhagen

Folate deficiency Creates Hitherto Unknown Problems in Connection with Cell Division

Folate deficiency can severely affect one of the most important processes in the body, cell division, researchers from the University of Copenhagen have demonstrated in a new study that folate deficiency can cause problems in connection with cell division and DNA replication. In fact, it creates far more damaging chromosomal abnormalities than previously known.

Folate is a type of vitamin B found in for example broccoli, spinach, peas, mushrooms, shellfish and fruit such as bananas and melon. The Danish Health Authority recommends that pregnant women and women trying to get pregnant take a daily supplement of folic acid. But everyone, not just pregnant and soon to be pregnant women, should focus on this vitamin, the last author of the study, Associate Professor Ying Liu from the Centre for Chromosome Stability at the Department of Cellular and Molecular Medicine, UCPH, who is a partner of the CHROMAVISION project, concludes on the basis of the findings of the study.

The researchers analysed the part or area of the genome called FRAXA, which contains an extensive so-called CGG sequence, a genetic code. Here they saw that folate deficiency caused abnormalities in connection with cell division, mitosis, especially in cells with an abnormally long CGG sequence. Among other things, the researchers also saw how the entire X chromosome became unstable in cases of long exposure to folate deficiency.

The study is funded by the Nordea Foundation, the US National Institute of Health, the Danish National Research Foundation and the European Union Horizon 2020 program. Ying Liu continued, "particularly, this study was conducted in association with the CHROMAVISION program. One of our future goals is to isolate chromosomes that are most affected by folate deficiency, for example, the chromosome X that has long CGGs, and then observe and analyse their segregation in vitro using the technologies developed by CHROMAVISION".

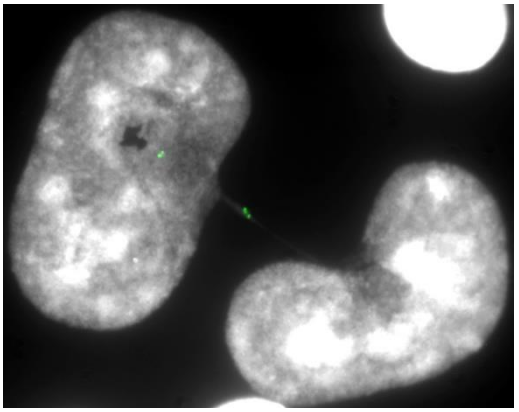


Figure 4 - Two daughter cell nuclei (white) from a Fragile X syndrome (FXS) patient separating from each other at the last stage of cell division. The green dots represent DNA at the FXS gene on the X chromosome, which are connected to the daughter cell nuclei by a thin DNA thread (white). *Image courtesy of Victoria A. Bjerregaard, Center for Chromosome Stability, University of Copenhagen, Denmark*

Read the paper (PNAS)

Stay tuned via our website or contact us directly!

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