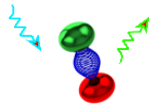
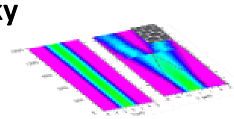
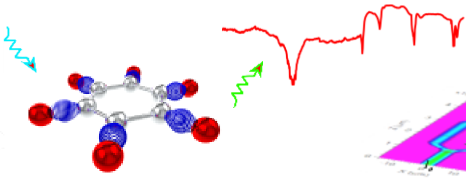
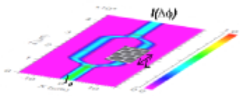








Light-on-a-Chip **Group**

Ilse Katz Institute for Nanoscale Science and Technology

Light-on-a-Chip *group is developing the multidisciplinary interface between nano-technology, physics and chemistry in order to establish* ***new approaches*** *to integrated systems for* ***emerging applications*** *such as* ***Point of Care*** *and* ***Doctor in Your Pocket Devices****, security and safety. Our research has introduced, on October 2015, a* ***new field*** *at Ilse Katz Institute for Nanoscale Science and Technology at Ben-Gurion University (BGU) and is aiming to bring BGU to the world level in field of Integrated NanoPhotonics during upcoming years.*

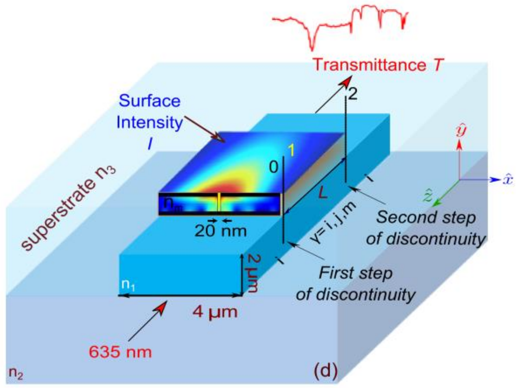


Fig. 1. General concept of Light-on-a-chip group. Karabchevsky *et. al Opt. Express 23* (2015).

Objectives

Excellence is evaluated by quality, originality, significance and rigour. We believe that the quality of a research and an excellence in performance has to be underpinned by the fundamental knowledge of basic science disciplines such as physics, chemistry and detailed scientific understanding of how materials, devices and systems perform in their operational environment. This solid knowledge needs to be kept up to date because new technologies, materials, manufacturing techniques and important applications emerge. *Impact* is concerned with benefit from the research in terms of publications and incoming grants. Activities of ***Light-on-a-Chip*** led by Dr. Alina Karabchevsky focus on, but not only, most promising opportunities in research for Point of Care considerations to *promote innovation* and bring ***Light-on-a-Chip*** group at Ilse Katz Institute for Nanoscale Science and Technology to the *world level*, *recognised by scientific community*.

Impact of Integrated Systems for BioMedical Applications

Since its widespread introduction, the volume of development of point-of-care devices increased over the 40 years. Its continuous growth is explained by dynamics in healthcare delivery which is aimed at delivering less costly care, easier to use, miniature and close to the patient. Considerable reduction in physical dimensions introduces novel types of phenomena. For example, continuous tendency and progress in downscaling electronic devices to the deep **nano-scale** have already brought to consideration the emergent miniature **nanophotonic** devices. Fundamental physical phenomena shaped by chemical control, influenced and tailored by disordered organic layers and surrounding nano-structuring on chip, no doubt will be the main challenge and the key feature of the future technological progress in general and particular in biomedical research. The demand on small handheld devices (Doctor in Your Pocket) providing qualitative or quantitative information is tremendous. According to BCC research analysis the global point of care diagnostics market reached $13.4 billion in 2010 and expected to reach $16.5 billion in 2016 for a compound annual growth rate (CAGR) of 3.7% from 2011 to 2016. This market is posed to grow at a CAGR of 9.3 % from 2013 to 2018, to reach $27.5 billion by 2018 (from MarketsandMarkets). As for the funding, Horizon 2020, the largest EU Research and innovation programme, has nearly $80 billion funding available from 2014-2020 to support Photonics research in general and Photonics for biomedical applications and security in particular. Funds for Photonic Integrated circuits' research valuated as $30M (ICT27) while integrated platforms of the healthcare valuated as $13M. Driven by the dream of untapped device functionality, integrated photonics studies the exciting science of the interaction of light with matter while light is guided on a chip. *The aim is to control light fast*

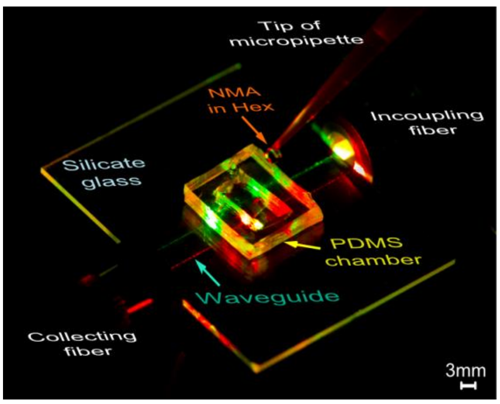
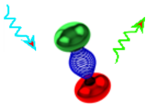
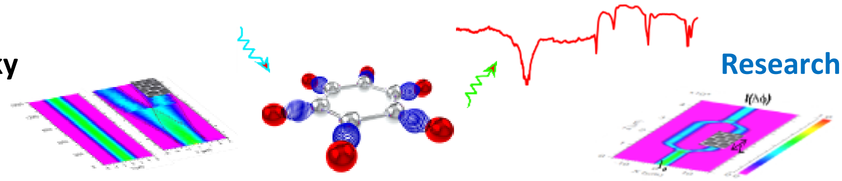


Fig. 2. Photograph of the integrated on chip spectrograph. A Karabchevsky and A K Kavokin, Nature: Scientific Reports **6**:21201, (2016).





within only a few oscillation cycles of the light wave), in a miniature device containing only a few layers of atoms using signals carried by only a few photons.

The Structure of *Light-on-a-Chip* Group at Ilse Katz Institute for Nanoscale Science and Technology

Research activities of ***Light-on-a-Chip*** at *Ilse Katz Institute for Nanoscale Science and Technology at Ben-Gurion University* encompasses fundamental theoretical investigations, computational physics projects (numerical modelling of complex integrated systems), computational chemistry simulations, design and fabrication of actual devices and experimental verifications of their performances. Our research program relys on two major directions: (1) Physical phenomena, manipulated on a chip by waveguides, with applications to biomedical devices, security and optical communication. (2) Light-matter interactions on nano-scale, with applications to integrated photonic devices and fundamental studies of bio-molecular dynamics on a chip. Experimental activities are based on a new lab for ***Light-on-a-Chip*** devices, resonant spectroscopy measurements and molecular science on a chip.

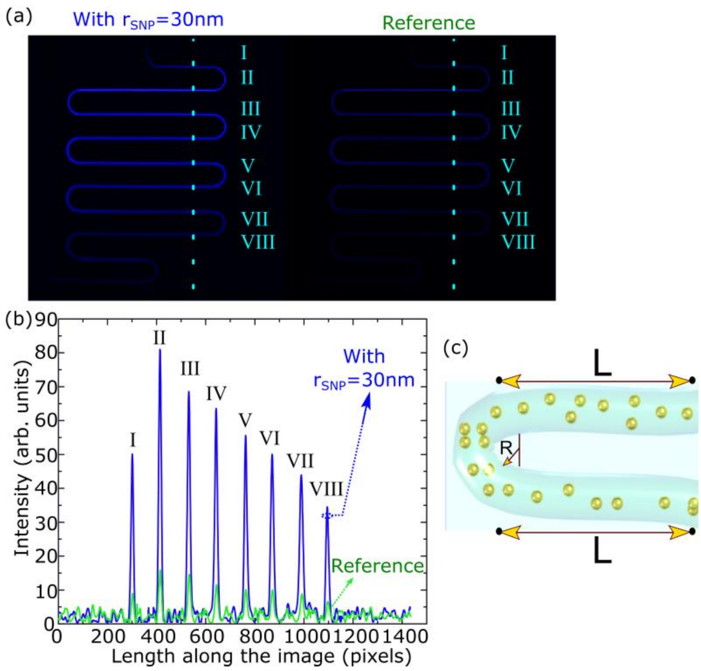


Fig. 3. Glowing Microfluidics on chip. Karabchevsky *et. al* Accepted by *Nature Light Science and Applications*.

Research Program

The present research activity involves multidisciplinary aspects of engineering, applied physics and chemistry, covering several timely topics, such as engineering of Integrated photonic devices and engineering of Nanoscale devices, Microfluidics (Figure 3) and Spectroscopy (Figures 2 and 4). In these fields we have made several significant contributions which rely on developed new theoretical models (Figure 1) and supporting experimental demonstrations (Figure 2).

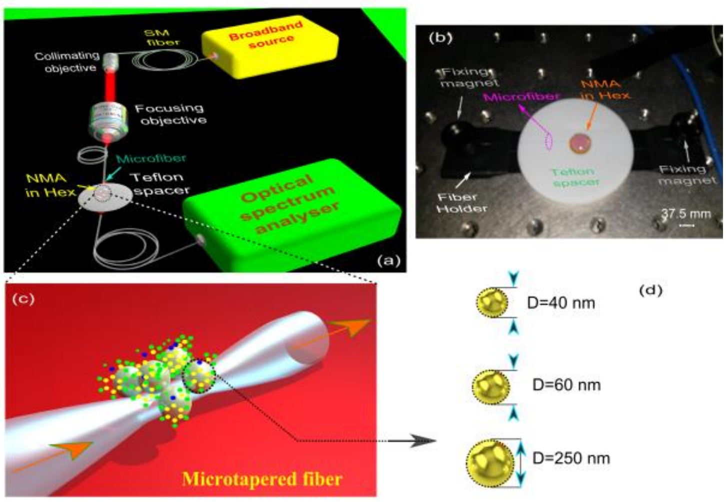


Fig. 4. Spectroscopy on Reconfigurable Microfibers. Karabchevsky *et. al* Under Review by *Nature Communications*.

Summary

The research performed in ***Light-on-a-Chip*** group covers promising new directions of nanophotonics. We benefit from a strong national (Israeli) and international cooperation. We confident that successful implementation of the envisaged experiments will lead to a major breakthrough in Integrated ***NanoPhotonics*** and result in appearance of a new generation of biomedical devices for a wide range of applications in medicine, sensing and also in information processing and lighting.