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Title:

Towards a compact lensless superresolution microscope based on nanoarrayed LEDs

Authors & affiliations:

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1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract
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One of the most recent advances in optical microscopy is superresolution, which uses bulky and expensive microscopes. Lensless microscopy also appeared recently as a cost-effective technique, and is currently mature enough. Lensless microscopes take advantage of the progress in microelectronics, providing cameras with decreasing pixel sizes and improving sensor resolution. Currently, pixel sizes smaller than ~1 µm are difficult to achieve in CMOS technologies.

Recently, the fabrication of GaN-based LEDs with sizes in the order of 1 µm has been demonstrated and predicted to scale down to the nanometer range, as necessary for superresolution. These small LEDs can be arranged in arrays and controlled individually to build a new concept of microscope in which the individual spots of light produced by the LEDs cast shadows of an object on a CMOS pixel. In this way we use spatially resolved illumination instead of spatially resolved detection. This microscope is lensless in nature, easy to manufacture and will profit of the continuous decrease of LED size to achieve superresolution.

This work presents the advances towards a superresolution microscope based on structured nanoLED illumination. The first version of this new microscope will be presented. The InGaN/GaN chip has 5 µm individually addressable LEDs distributed on an array of 8x8 with 5 µm pitch. They were switched on and off consecutively to cast shadows on a 16x16 array of CMOS SPADs. In the microscope, one SPAD is selected to measure the light coming from the different LEDs through the object. Fig. 1 shows the shadow casted by a standard grade grid with 400 mesh when switching on two different LEDs and the microscope setup. Triaxial micropositioners are used to hold the camera and the sample, while the LEDs are fixed. At the conference we will present our last results with this new technique.

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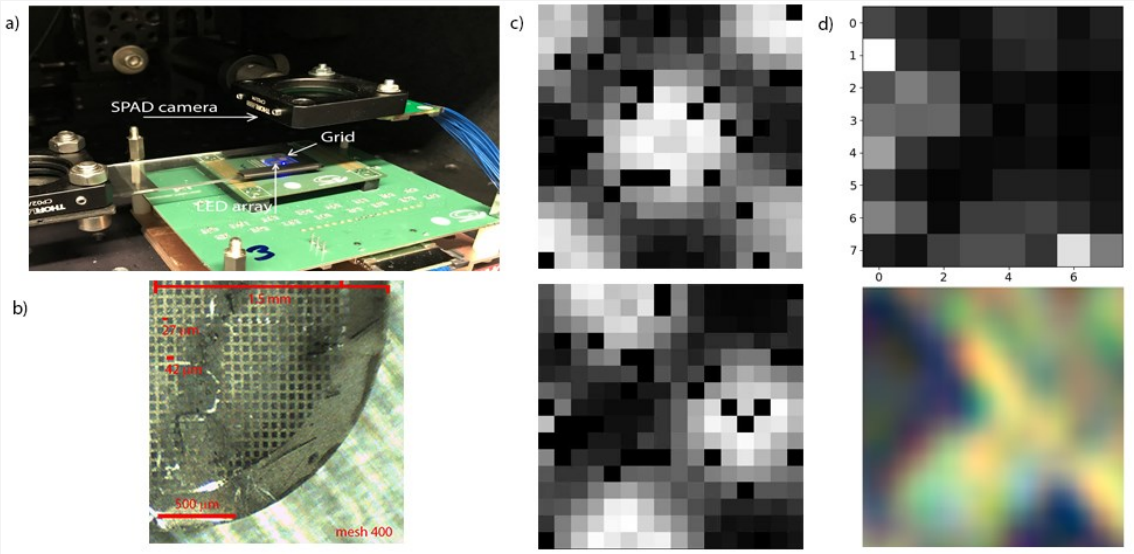

Fig. 1: (a) Microscope setup. (b) Grid used for observation. (c) Shadows obtained on the SPAD camera for (top) LED (0,0) and (bottom) LED (4,0). (d) LED Image: composition obtained taking one SPAD signal and linking it to each LED. On the bottom is the grid oriented and sized similar.