

# HIGH-NA DIFFRACTIVE ARRAY ILLUMINATOR FOR A MULTI-SPOT SCANNING MICROSCOPE

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An array of apertures can be used to generate an array of spots across a large field at a large working distance via the Talbot-effect. Drawbacks of these Talbot array illuminators are the low NA and the low efficiency. Here we report on an array illuminator with NA up to 0.75 and efficiency up to 40% based on binary phase diffractive optics. The design of these array illuminators is based on physical optics based back and forth propagation between the array illuminator plane and the spot array plane, and comparing the desired spot profile with the actual profile resulting from a specific binary phase structure. Experimental array illuminators ( $\lambda = 655 \text{ nm}$ ,  $\text{NA} = 0.75$ ,  $\text{pitch} = 9.5 \text{ }\mu\text{m}$ ,  $\text{WD} = 0.54 \text{ mm}$ ) have been made with e-beam writing giving rise to spots with  $\text{FWHM} = 0.5 \text{ }\mu\text{m}$ . These phase structures have been used to make a multi-spot scanning microscope setup (with a 20X/NA0.40 objective for collection, a VGA high-speed CMOS-sensor and MatLab post-processing), resulting in images with  $1 \text{ }\mu\text{m}$  resolution (limited by alignment accuracy). Novel contrast modalities like 3D and phase imaging are enabled by tailoring spot profiles and the use of post-processing.

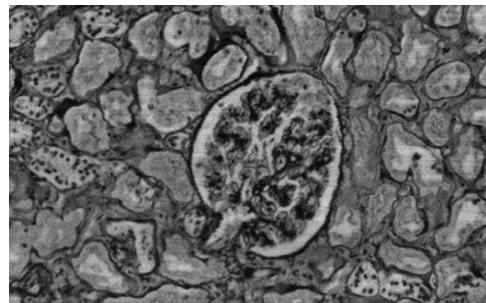
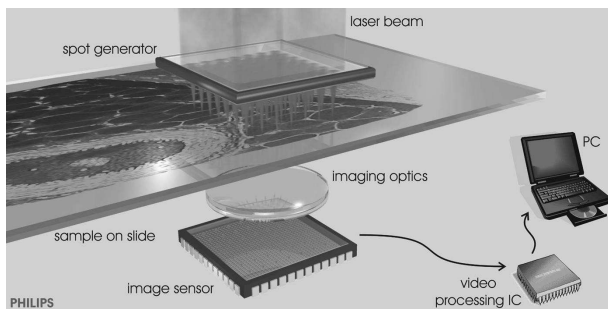
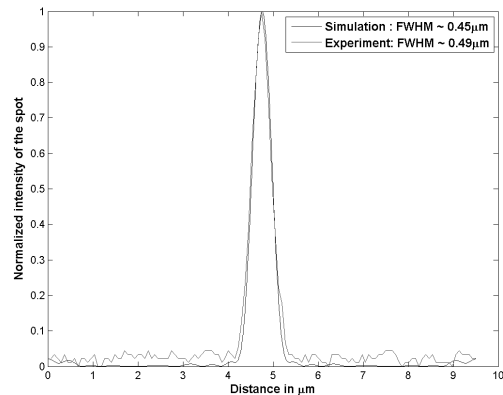
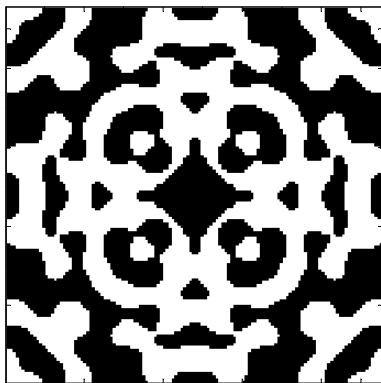


Figure 1. Unit-cell of array illuminator (upper left), calculated and measured spot profile (upper right), schematic view of setup (lower left), image of stained kidney (lower right).