

Metalens-based microfluidic sorter

Shengqi Yin, Nicolas G. Green and Xu Fang
University of Southampton

Introduction

Metalens is an array of judiciously designed nanoparticles that can focus light, a functionality that allows it to replace the conventional glass lenses in many applications. Here we present a metalens-based microfluidic particle sorter that enables automatic particle sorting based on the fluorescent colour of the particle. The sorting originates from the fact that the metalens can focus fluorescent light back onto the target particle, creating self-induced optical tweezers.

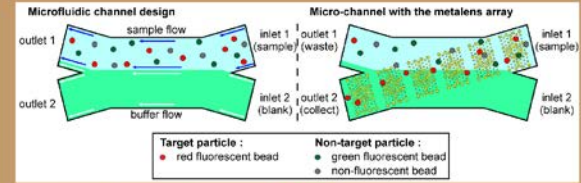
Results

The metalens has two layers, each imparting a different phase profile on incident light. The phase profile of the top layer focuses the fluorescent light from the target particle onto the second layer of the metalens. The second layer imparts designated momentum change to the light, creating retroreflection. The combined effect of these two layers is that the light radiated by the target particle is focused back onto the fluorescent particle. The particle is consequently trapped by its own emission, and moves along the desired route and enables the sorting.

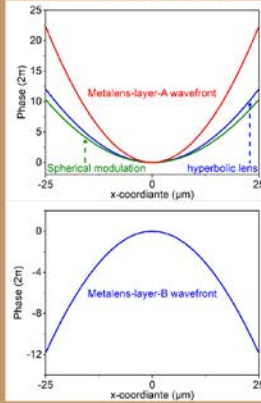
Conclusion

Our research aims to integrate metalens, an emerging research area in nanophotonics, with microfluidic platforms to create small and portable sensors with novel detection functionalities. The microfluidic particle sorter presented here follows our recent two publications in this direction, and it is currently under experimental development.

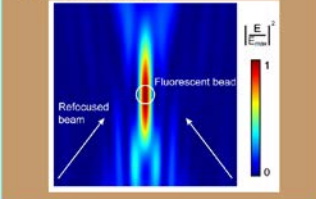
Design schematic



Metalens phase profiles



Refocused field



Acknowledgements

The authors acknowledge the use of the IRIDIS High Performance Computing Facility, and associated support services at the University of Southampton, in the completion of this work.

Methods

The design presented here is numerically evaluated using software of COMSOL Multiphysics and Lumerical.