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The NEMO educational kit

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Abstract

NEMO is a European "Network of Excellence in Micro-Optics" One of the objectives is to disseminate knowledge on micro-optics. Therefore NEMO plans to inform pupils about the crucial role of micro-optics. This will be done through the distribution of an educational kit to their physics/technology teachers. The kit will contain a variety of replicated micro-optical refractive and diffractive components, and a semiconductor laser source. The kit will be supplemented with a booklet with DVD. Possible experiments and experimental setups are proposed, explained and illustrated. On the same DVD some simple optical designs will also be illustrated.

Key words

optics education, optics kit, micro-optics, diffraction, diffractive elements

Summary

NEMO is the "Network of Excellence in Micro-Optics" constructed under the European "Sixth Framework Programme". It aims at providing Europe with a complete Micro-Optics food-chain, by setting up centers for optical modeling and design, measurement and instrumentation, mastering, prototyping and replication, hybrid integration and packaging, reliability and standardization. More than 300 researchers from 30 groups in 12 countries participate in the project.

One of the objectives of NEMO is to spread excellence and disseminate knowledge on micro-optics and micro-photonics. Therefore NEMO plans to inform pupils, already from secondary school level onwards, about the crucial role of light and micro-optics and the opportunities this combination holds. This will be done through the distribution of a user-friendly and well illustrated educational kit to their physics/technology teachers. The latter will contain a variety of replicated micro-optical refractive and diffractive components, fabricated with the aid of the network technology centers, a semiconductor laser source and a clear and instructive manual for basic experiments. The kit will be packaged in a box, to be paid by SPIE-Europe. It will be self-consistent: schools with no optical instrumentation will be able to use it for basic demonstration. However it should also be possible to use the elements in more complicated setups to be constructed by the users themselves.

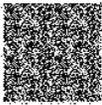
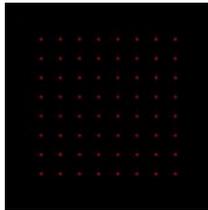
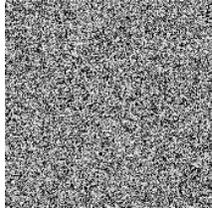
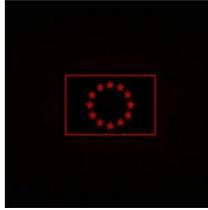
The kit will be supplemented with an educational booklet with DVD, which explains the use of the components at different levels: low-level explanations for secondary schools, and more sophisticated explanations for high schools or universities. Possible experiments and experimental setups are proposed, explained and illustrated. On the same DVD some simple optical designs will also be illustrated.

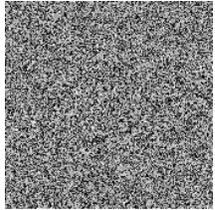
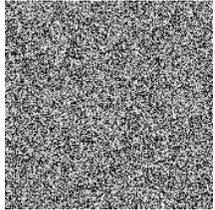
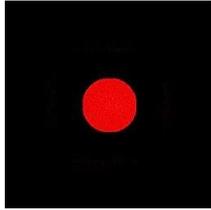
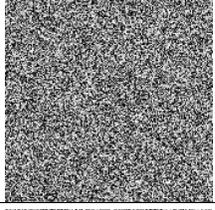
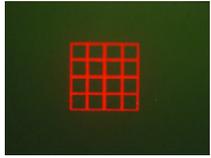
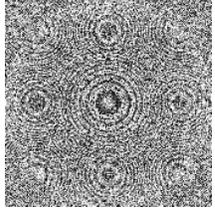
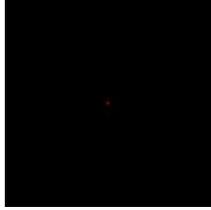
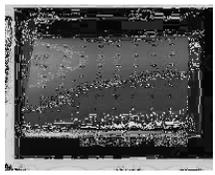
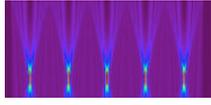
The same manual and kit will be made available to high school and university students and to their professors upon request via the NEMO portal.

The NEMO educational kit is now under construction; its realization is scheduled for february 2006. However prototypes of some of the optical elements are already available and will be demonstrated. We show, among others, diffractive optical elements which transform a laser beam into a square grid, a uniform light distribution, a European flag, the NEMO logo.. {these optical elements are modeled and realized by Mo Taghizadeh and Andrew Waddie at the Heriot Watt University in Edinburgh, Scotland}. Some of those optical elements, with some technical details, are illustrated below.

The NEMO educational kit is the result of a collaboration of many researchers all over Europe, too many to name them all. At the conference due acknowledgement will be given.

NEMO EduKit Diffractive and Refractive Micro-Optical Elements

Element Name	Phase Profile	Output Profile (simulated unless otherwise noted).	Description
1x2			Simple 1D grating with a range of grating periods (16 μ m, 32 μ m, 64 μ m, 128 μ m and 256 μ m).
8x8			Increased fan-out element – binary EOM with grating period of 256 μ m.
EU outline			16 phase level pattern formation DOE (PF-DOE) generating the outline of the EU flag. Grating period is 512 μ m.

<p>NEMO outline</p>			<p>16 level PF-DOE generating the NEMO logo. Grating period is 512 μm. Experimental result.</p>
<p>On-axis Flattop</p>			<p>On-axis flattop generator. 16 phase levels, period = 512 μm.</p>
<p>Grid</p>			<p>16 level PF-DOE which generates a grid pattern. Period = 512 μm. Experimental result.</p>
<p>Diffractive Lenses</p>			<p>16 phase level diffractive lenses with focal lengths of 10 μm, 50 μm and 250 μm.</p>
<p>Refractive Lenses</p>			<p>Refractive microlens arrays fabricated using thermal reflow technique. A range of square and hexagonal close packed spherical and square packed cylindrical lenses are provided.</p>