



PhD in FISICA / PHYSICS - 39th cycle

PNRR 117 Research Field: HIGH-INDEX OPTICAL MATERIALS FOR NANOPHOTONIC APPLICATIONS

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The augmented and virtual reality (AVR) is a new concept that describes the multilevel interaction between people, in which the real and virtual world are interlaced. The ultra-broad band Internet and the ubiquity of smart devices connected to a plethora of content providers has led to an increasing overlap of our digital and physical lives. Although such interactions use our sight and hearing, they are presently mediated by a multitude of devices unnaturally connected to human senses. Luxottica, a worldwide leading company in the eyewear market, has started a highly innovative project, in collaboration with Politecnico di Milano (POLIMI), to design and develop the eyewear of the future. The aim of the research project is to turn eyeglasses into the portal to the AVR, exploiting their natural coupling to our vision. In the long run, this result will be achieved by adding revolutionary capabilities of the AVR to commonly used glasses designed to correct vision impairments and protect the eyes from the sunlight. The main objective of the PhD program is the development and characterization of high-quality, high-index dielectric materials for the integration of nanophotonic devices for augmented reality applications. The PhD project fulfils the requirements of the Next Generation EU in terms of innovation and strengthening competitiveness. The functionalities of smart eyewear will also help to increase inclusion and social relations.

Methods and techniques that will be developed and used to carry out the research

The eyewear of the future, featuring immersive AVR



research	<p>functions, requires new photonic devices that combine digital images with the vision of the real world in a natural and comfortable way. The envisioned nano-photonic devices will be integrated on top or embedded inside the lens and will therefore require materials featuring a refractive index higher than that of the lens itself. The research and development activities will consist of four main tasks.i). Deposition of high-index materials (oxides and other alloys) by means of chemical vapor deposition, atomic layer deposition, sputtering techniques, sol-gel spin coating, or other techniques.ii) Structural and morphological characterization by means of x-ray diffraction, atomic force microscopy, scanning electron microscopy, or other techniques. iii) Optical characterization by means of VIS-IR spectroscopy, ellipsometry, or other techniques.iv) Coordination of the material engineering activities with those of nano-optical design and nanofabrication.The topic addressed by the research project belongs to the fabrication of photonic devices, an EU Key Enabling Technology.</p>
Educational objectives	<p>The PhD candidate will work in a multidisciplinary team including top researchers in nanofabrication, photonics, electronics, and artificial intelligence. The student will develop their main skills in optical materials and material science in general, including the growth and the analysis of optically transparent layers. They will also learn the basics for the fabrication of nanostructures, such as e-beam lithography, e-beam evaporation, and reactive-ion etching. The student will also learn the basics of digital holography, diffractive optics, physics of metamaterials, computational methods, and system integration.</p>
Job opportunities	<p>The candidate will work in the Joint Research Center POLIMI-Luxottica and carry out an internship at a Luxottica site in Italy or abroad. Job opportunities will be in companies that develop devices and photonic systems for AVR, which represent a highly innovative and promising technology.</p>
Composition of the research group	<p>1 Full Professors 0 Associated Professors 1 Assistant Professors</p>



	1 PhD Students
Name of the research directors	Giovanni Isella

Contacts
<p>Prof. Giovanni Isella</p> <p>giovanni.isella@polimi.it</p> <p>https://lness.como.polimi.it/sige.php</p>

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Luxottica
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	The PhD student will have the opportunity to do an internship in a leading foreign University.
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities: (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): financial aid per PhD student per 3 years: max 5.707,20 euros per student.</p> <p>Teaching assistantship: There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p> <p>Computer availability: Individual use.</p> <p>Desk availability: Individual use.</p> <p>Other information</p> <p>Industrial Partner Luxottica is a world leader in the design, manufacture, and distribution of high-end, luxury, and sport eyewear with a revenue of ~ ? 9.5 billion/year (2019). Since 2018, it</p>



has been part of the EssilorLuxottica Group, a reference company for the design, production and distribution of ophthalmic lenses, prescription eyewear, and sunglasses. The company has more than 180,000 employees and a strong global presence.