



TARJETA INFORMATIVA

<b>PARA</b>	<b>Dr. Alfonso Padilla Vivanco</b> Secretario Académico de la UPT
<b>DE</b>	<b>Dr. José Humberto Arroyo Núñez</b> Director de Investigación y Posgrado
<b>ASUNTO</b>	<b>Conclusión de Proyecto</b>
<b>FECHA</b>	23 febrero 2022

Por medio del presente documento le informo que el proyecto de investigación que lleva por título:

**"Characterizations and Use of Recycled Optical Components for Polarizing Phase-Shifting Interferometry Applications"**

El resultado de este trabajo, ha sido publicado en una revista de alto impacto.

Se anexa al presente documento la evidencia de la publicación.

<https://doi.org/10.3390/photonics9030125>

<https://www.mdpi.com/2304-6732/9/3/125/htm>

Sin más por el momento quedo a sus órdenes.




ATENTAMENTE





Article

# Characterizations and Use of Recycled Optical Components for Polarizing Phase-Shifting Interferometry Applications <sup>†</sup>

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<sup>†</sup> This paper is dedicated to the memory of our marvelous colleague, Doctor Gustavo Rodríguez Zurita. “That person who helps others simply because it should or must be done and because it is the right thing to do, is genuine without a doubt, a real superhero (SL)”.

**Abstract:** In this research, we report using optical components such as cubic beam splitters, lenses, diffraction gratings, and mirrors from broken, obsolete, or disused electronic devices to implement a simultaneous polarization-based phase-shifting interferometric system. The system is composed of a polarized Mach–Zehnder interferometer (PMZI) which generates a sample pattern coupled to a 4f imaging system with a diffraction grating placed on its Fourier plane. Such a diffractive element replicates the pattern generated by the PMZI, and each replica is centered and modulated by each diffraction order generated by the grating. The corresponding individual phase shifts are controlled by placing linear polarizers with known angles in front of each replica. Experimental results are presented using several phase samples such as an oil drop, a pseudoscorpion claw, a microarthropod, and red blood cells. In addition, a comparison of the retrieved phase was conducted by employing two different phase demodulation algorithms.

**Keywords:** interferometry; phase shifting; polarization



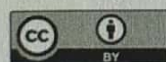
**Citation:** Islas-Islas, J.M.; Reséndiz-López, G.; Ortega-Mendoza, J.G.; García-Lechuga, L.; Quiroz, A.; Serrano-García, D.-I.; Canales-Pacheco, B.; Toto-Arellano, N.-I. Characterizations and Use of Recycled Optical Components for Polarizing Phase-Shifting Interferometry Applications. *Photonics* **2022**, *9*, 125. <https://doi.org/10.3390/photonics9030125>

Received: 1 February 2022

Accepted: 14 February 2022

Published: 23 February 2022

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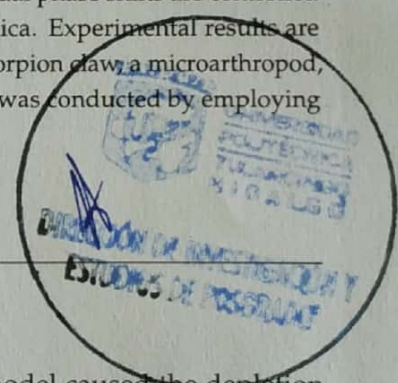
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## 1. Introduction

In the last few decades, the so-called brown economic model caused the depletion of natural resources, degradation, and widespread loss of ecosystems. As a response, an alternative economic model emerged called the green economy. An essential part of the green economy model is the circular economy practice of reducing, reusing, and recycling (3R scheme) [1,2]. Following this 3R scheme, we implemented a polarization-based phase-shifting interferometric system using recovered optics from electronic waste [3].

Today, throwing away CD/DVD reading devices and broken or obsolete projectors is prevalent. However, those devices are sources of good-quality optical components such as lenses, mirrors, diffraction gratings, cubic beam splitters, polarizer sheets, and Fresnel lenses, among others that can be used in the implementation of interferometric systems. Currently, several industrial sectors and academic fields incorporate optical and photonic technologies for quality inspection metrics [4–7]; therefore, it is important to develop interferometric techniques and devices capable of contactless high-precision measurements applied to phase objects [4–10].

There are a wide variety of techniques to perform these measurements, mainly based on the recovery of the optical phase. Several methods are applied in this field, with Fourier







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<b>ASUNTO</b>	<b>Conclusión de Proyectos Ene- Mar 2022</b>
<b>FECHA</b>	09 marzo 2022

En atención a la solicitud de Información de los Proyectos concluidos en el Periodo Ene-Mar 2022. Me permito informarle que, en el presente periodo, contamos con un Proyecto Concluido " *Characterizations and Use of Recycled Optical Components for Polarizing Phase-Shifting Interferometry Applications*", además de que los profesores investigadores se encuentran en proceso de la generación de otros 3 proyectos de corte científico tecnológico, y es probable tener evidencia de su conclusión el siguiente trimestre.

Los nombres finales de los 3 proyectos en proceso pueden redefinirse en función de las metas y objetivos alcanzados, por lo que los títulos son únicamente una propuesta.

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