وزارة التعليم العالي والبحث العلمي

جامعة المثنى كلية العلوم

قسم الفيزياء

دراسة نظريه لتولد الطيف الفائق الاستمرارية في الالياف البلورية الفوتونية غير المتناظرة في الاتصالات الضوئية

رسالة مقدمة الى مجلس كلية العلوم/ جامعة المثنى

كجزء من متطلبات نيل درجة الماجستير في علوم الفيزياء

من قبل

هنادي يعقوب يوسف

بكالوريوس علوم فيزياء 2016

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1444هـ

2023م

ABSTRACT

Photonic Crystal Fibers (PCFs) have recently drawn significant attention in both academic and industrial environments. With an emphasis on all-fiber device configuration, the design of liquid-based tunable photonic devices and their applications in optical communications have been developed. Liquid crystal infiltration into PCFs offers an appropriate common platform for designing and fabricating straightforward, all-fiber tunable photonic devices that are simple to integrate with optical fiber networks.

Numerical simulations play an important role in the design and modeling of PCFs. In this thesis, the full vectorial finite element method (FV-FEM) with perfectly matched layer (PML) boundary condition is successfully used for this purpose based on COMSOL Multiphysics environment Version (5.4) and Matlab software.

This thesis is devoted to asymmetric microstructured optical fibers with a special focus on the dynamics of the supercontinuum (SC) and their evolution. In order to concentrate and collimate the light well, SC light sources are typically utilized for operations that need light with a wide optical bandwidth but high spatial coherence. First, the modal analysis results of the asymmetric design of N-BK7 PCF infiltrated with carbon disulfide CS_2 material are presented. The numerical results reveal that the proposed design offers ultra-broadband SC spectra of 8182 nm and 3009 nm at wavelengths of 1550 nm and 1300 nm, respectively, with a remarkably small compact device length of 5 mm. Then, the background material is replaced by Soft glass material of type SF57, the core was made of As_2S_3 chalcogenide glass surrounded by a layer of E7 LC. In this investigation, the numerical results reveal that the bandwidth of the generated spectrum can be tuned electrically, and thermally. An ultra-wideband SC of 6531 nm, 6681 nm, and 6370 nm at the temperatures 15 °C, 25 °C, and 35 °C,

respectively at the peak power, fiber length, and pulse width of 5 kW, 5 mm, and 50 fs at ϕ=90° as a rotation angle and λ=1550 nm was obtained in this study. Besides that, at ϕ=0° the bandwidth of the SC spectrum is found to vary between 12315 nm, 11025 nm, and 9465 nm, respectively at the same input parameters. The performance of the SCG has been thoroughly investigated in terms of suggested fiber length, pumping peak power, geometrical parameters, the rotation angle of the LC director, and operational wavelength.

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Theoretical Study of Supercontinuum Spectrum Generation Based on Asymmetric Photonic Crystal Fiber in Optical Communications

A Thesis Submitted to the Council of College of Science / AL Muthanna University as Partial Fulfillment of the Requirements for the Degree of Master of Science in Physics

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B.Sc. in Physics 2016

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2023 AD **1444AH**