MOCCA ESRs' Newsletter

In this issue:

MOCCA ESR Loredana Massaro's project: "Nonlinear semiconductor platforms for optical microcomb Generation"

MOCCA ESR Loredana Massaro presents her project.

Read more on page 2-3.

Find out more about MOCCA EID project

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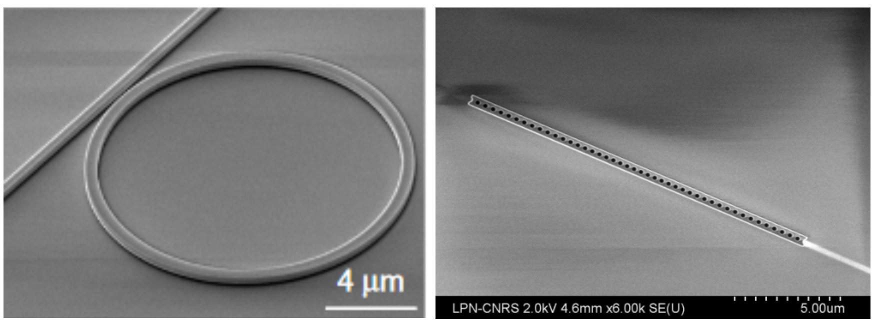
MY PROJECT…..

The title of my project is **"Nonlinear semiconductor platforms for optical microcomb Generation"**

Its goal is to model, fabricate and characterize experimentally a frequency comb source in an integrated circuit. While frequency comb generation has already been achieved thanks to integrated ring microresonators, the underlying idea of my project is to generate such a frequency comb using photonic crystal cavities.



Microring and photonic crystal SEM images.

Images: Ring resonator : Chang, L., Xie, W., Shu, H. et al. Ultra-efficient frequency comb generation in AlGaAs-on-insulator microresonators. Nat Commun 11, 1331 (2020). https://doi.org/10.1038/s41467-020-15005-5 Photonic crystal cavity : Alexandre Bazin, III-V Semiconductor Nanocavitieson Silicon-On-Insulator Waveguide: Laser Emission, Switching and Optical Memory.

….AND ITS PROGRESSES

The first step toward the fabrication of a frequency comb source based on a Photonic Crystal (PhC) cavity is the modelling of such a structure. In order construct the final PhC cavity, I implemented codes studying its elementary components i.e. photonic crystals.

Each photonic crystal is represented in the software « Lumerical » as a semiconductor waveguide drilled with one periodic array of holes and surrounded by silica. Two mechanisms of light confinement are present in these structures: Total Internal Reflection (TIR) and the apperarence of the Photonic Band Gap (PBG). TIR provides transverse confinement of light and it is possible to confine light in the desired range of frequencies exploiting the PBG's shift obtained thanks to the variation of the designed parameters of each PhC.

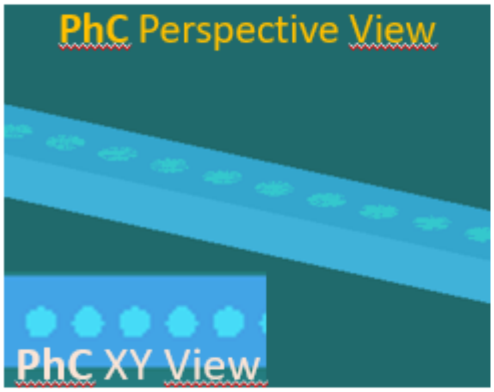
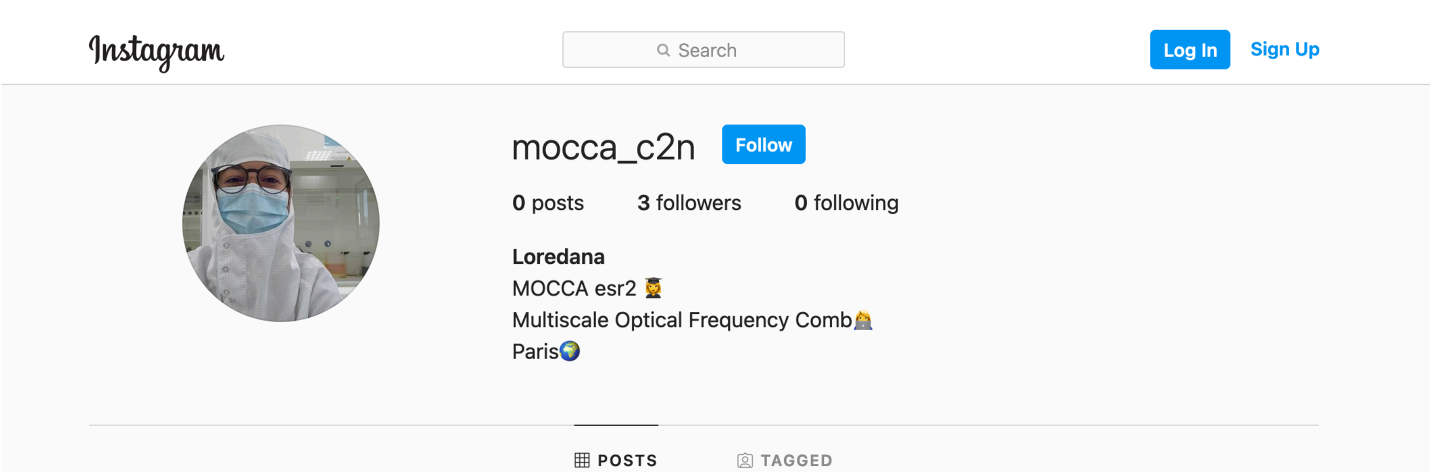


Figure 1 PhC View in Lumerical

To construct the final PhC cavity starting from its elementary components, it is necessary to study the electric field of each PhC. Using the decay of the electric field while in the PBG, it is possible to shape the first order mode of the final PhC cavity into a gaussian mode, implementing the so called « gaussian apodization». Once the final PhC cavity is designed with the assumption of having a first order gaussian mode at the frequency of interest, the higher order modes will follow the expression for the eigenvalues of a harmonic oscillator, and we end with the well known equidistant energy spectrum, that is the frequency comb we were looking for!

My work is on Instagram! Follow mocca_c2n



You can follow the progress of MOCCA ESR's research on our blogs and social media:
See https://mocca.astonphotonics.uk/blog/

MOCCA_EID is a project coordinated by Aston Institute of Photonic Technologies, Aston University Birmingham.

MOCCA's Partners:

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