Random Laser using Crystalline Nanopowders

Jonas Jakutis Neto[1], *Cristiano Monteiro de Barros Cordeiro*[2], *Christiano José Santiago de Matos*[3], *Niklaus Ursus Wetter*[1]
[1]Centro de Lasers e Aplicações, IPEN – Av. Prof. Lineu Prestes, Cidade Universitária, São Paulo - SP, Brazil
jjneto@ipen.br, nuwetter@ipen.br
[2]Programa de Pós-Graduação em Engenharia Elétrica, Universidade Presbiteriana Mackenzie, São Paulo - SP, Brazil
[3]UNICAMP, Instituto de Física 'Gleb Wataghin', Campinas - SP, Brazil

Abstract

We present our project of a random laser based on crystalline nanopowders. The main objective is to achieve cw emission with diode pumping and increased collimation of the output beam using photonic crystal fibers.

Summary

Accidentally discovered in1968 by Lethokov [1], the random laser has some distinct features not equaled by any other laser. These are basically emission at new wavelengths with ultra low gain, strong narrowing of the emission linewidth, emissions at multiple frequencies, ultra-low laser threshold and short pulse generation. Additionally, these lasers can be smaller than one micrometer. On the other hand, there are a lot of inherent problems to be mastered, one of which is the incoherent 3D emission.

This project, intends to start research on the emission properties of random lasers thereby approaching technological applications and thus allowing the effective use of the peculiar spectral and temporal characteristics of these lasers. Particularly, we will investigate continuous emission, diode pumping and collimation of the output beam.

Background data shows recent works (since 2001) on continuous pumping of random lasers by electron beam and, especially, the first optical, continuous pumping using argon laser [2]. Also, a recent experiment used a photonic crystal fiber to achieve partial guiding effects of the random laser emission.

Initially, rare earth doped crystals will be used to produce the powders (Nd:YLF, Nd:YVO_4, Nd:YAG) of several micron sized grains, suspended in a non-index-matching fluid and inserted into capillaries and hollow-core PCFs.

Crystalline powders have two advantages; they may be produced with higher dopant concentrations and different stoichiometries when compared to bulk crystals and can be produced with low costs, using a μ-pulling-down technique or zone-refining techniques.

Depending on scattering mean free path, PCF geometry and suspension liquid, we will optimize the guidance of the random laser emission.

References

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