Coupled random laser resonators in DNA thin films: fabrication and characterization

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Abstract
Random lasers are characterized by the absence of a cavity as such and rely on multiple scattering for feedback.[1] The latter has been customarily provided by a diffusive material mixed with the gain material, but it does not constitute a necessary requirement and the two functionalities can be embodied by different components.[2] In trying to customize the active regions and mirrors in this kind of lasers we propose a new way to prepare the devices with high control over the size and position of individual *mirrors* and characteristics of the gain material.
Here we report on the preparation of random laser consisting of two or more titania powder clusters embedded in a film of DNA-CTMA complex doped with DCM dye. The device is made by laser-drilling several holes in the polymeric film (for subsequent use as template). In a second step the holes are filled with a TiO_2 nanoparticles solution and allowed to dry. Next, the template is removed leaving only the clusters on the substrate. Finally, the clusters are covered again with dye-doped polymer film to get the final device. An SLM-shaped laser beam profile is used to optically pump the device establishing interactions between clusters involved in forming the c*avity*. Not only the length of the pumped segments and the roughness of the clusters play a role in selecting the modes involved in the laser action [3] but the film thickness determines the wavelength range where they appear.

References
[1] Wiersma, D. S. The physics and applications of random lasers. Nat. Phys. 4, 359–367 (2008).
[2] Consoli, A. & López, C. Decoupling gain and feedback in coherent random lasers: experiments and simulations. Sci. Rep. 5, 16848 (2015).
[3] Consoli, A & López, C; Emission regimes of random lasers with spatially localized feedback, Opt. Express in press (2016)

Figures

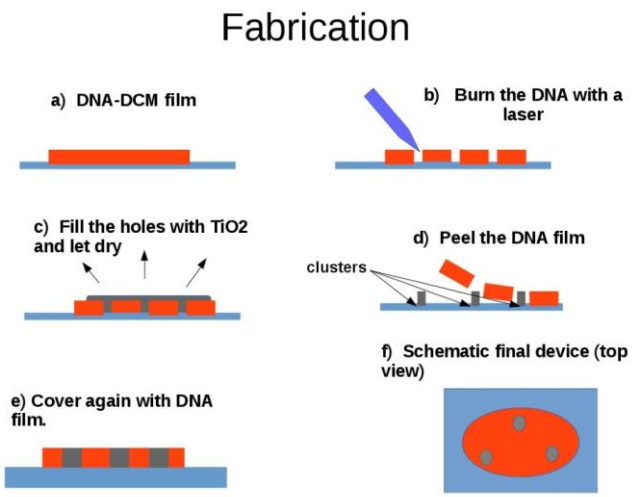

Figure 1:
Fabrication process. See text.

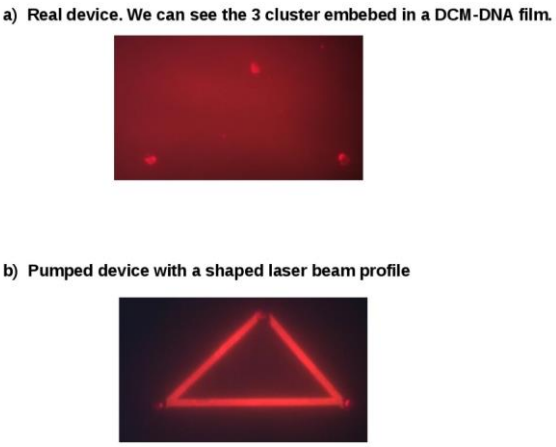

Figure 2:
a) Clusters size are around 100 microns and the distance between them is around 1.2 mm.
b) Optical pump made with a Spatial light Modulator.