Nano/microbubbles enhanced diffuse plasmonic nanoparticle-dye random laser

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Random lasers containing plasmonic nanoparticles (NPs) can exhibit speckle-free and tunable lasing emission. However, understanding of the physical mechanisms of the NPs enhancement that give rise to the emission with coherent feedback is poorly understood [1]. It has been suggested that these sharp emissions with linewidth less than 1.0 nm depend on several processes, including random variations of the refractive index of the gain medium, absorption induced localization, amplified extended modes and intrinsic quasimodes [2,3]. Better understanding of the lasing mechanisms would allow novel designs to balance losses and maximize emission for several applications, i.e. bio-imaging, photonics barcode and friend-foe identification [4].

The random laser consists of suspended TiN NPs in solution of Rhodamine B dissolved in ethanol. By a confocal microscope with a spectrometer and hi-speed camera, it is revealed that the emission spectra exhibit sharp spikes with linewidth less than 1.0 nm, indicating coherent feedback. Together with the CCD images, these results demonstrate that plasmonic-induced nano/microbubbles act as a weakly scattering system and plays an important role in the diffusive random lasers.

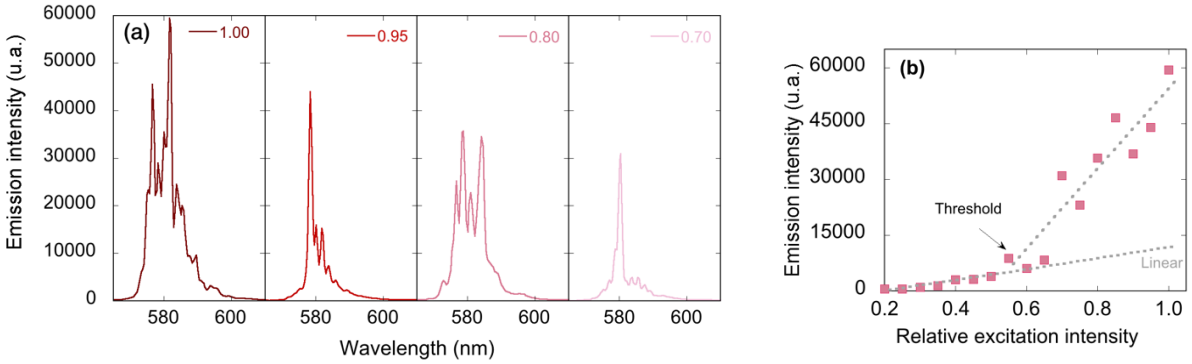

Fig. 1: (a) Emission spectra and (b) the dependence with excitation intensity of the random laser with TiN NPs dispersed in rhodamine B ethanol solution. Light excitation relative to 203 mJ cm^{-2}.

References

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