Injection-Seeded Optoplasmonic Amplifier in the Visible

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An optoplasmonic amplifier, operating in the visible (563 – 675 nm) and injection-seeded by an internally-generated Raman signal, has been realized and will be described. Dye molecules, tethered to the surface of a spherical microresonator by a protein, provide optical gain for the Raman (Stokes) radiation generated within the whispering gallery mode (WGM) resonator, or from the tether protein, by a laser (632.8 or 532 nm) pump source (Fig. 1a). Although the gain medium is located external to, and surrounds, the resonator, it lies well within the evanescent optical field of the resonator and, therefore, specific WGMs (Fig. 1b) associated with the spherical resonator harvest energy efficiently from the optically-pumped molecules. Because the amplifier gain does not build up from the noise, the coincidence of the Raman "seed" wavelength with a particular resonator mode has the effect of discriminating against all other modes. Energy stored under the amplifier gain profile is extracted predominantly in a single line and power is coupled out of the resonator by a plasmonic array.

Owing to the narrow linewidth of the injection seed that is available with Raman scattering and the potential for energy storage in the gain medium surrounding the resonator, the coherence and output power of this visible emitter can be superior to those of existing nano/micro- optical sources. The compound photonic-plasmonic device reported here provides an optical system well-suited for parallel, distributed systems for storing, amplifying and routing optical power.

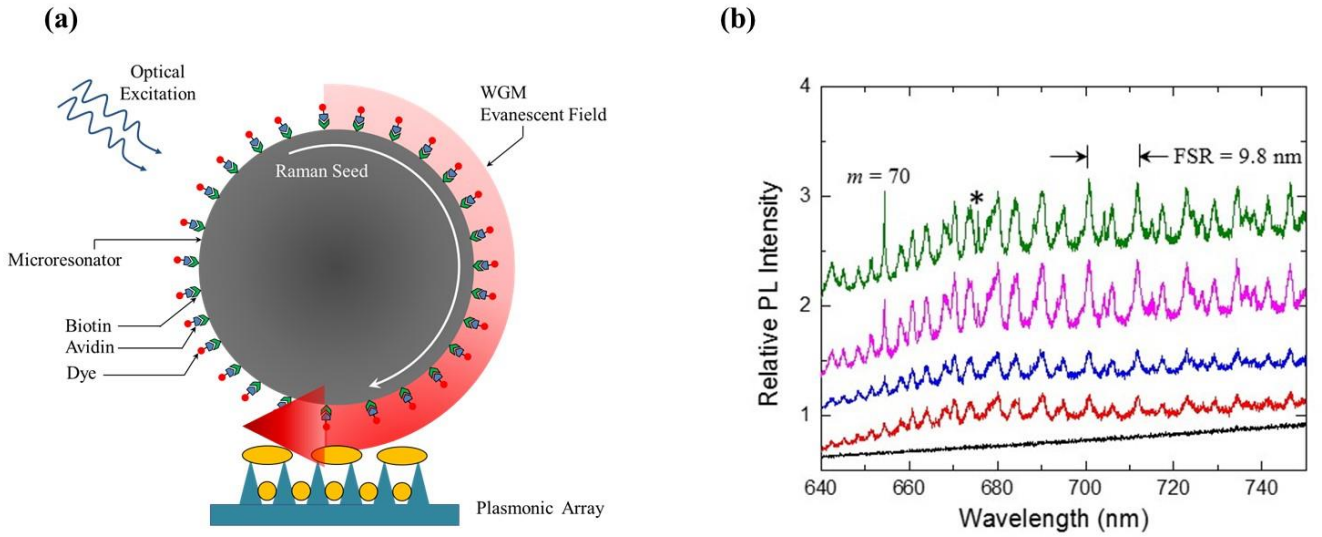

Figure 1: (a) Schematic of the optoplasmonic amplifier showing the operation of injection seeding. (b) Photoluminescence (PL) spectra in the 650-750 nm region for an amplifier incorporating a d =10.1 μm resonator to which Dylight 650 dye is conjugated. Five spectral scans, recorded for λ = 632.8 nm pump powers ranging from 24 nW to 20 μW, are given.