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Optical nanofibers immersed in liquids for highly efficient Stimulated Raman Scattering

Optical tapered nanofibers (NFs) are fabricated by pulling fibers until reaching diameters comparable or smaller than the light wavelength (fig. 1, left). These devices are significantly exploited for a wide range of potential applications. Indeed, at such diameters, NFs exhibit a strong confinement of light in the silica which enables the generation of nonlinear effects. NFs can also present an intense evanescent field which has been exploited for optical sensing [1], optical traps [2] or spectroscopy [3]. However, the experimental investigation of optical nonlinearities in the evanescent field of the NFs remains limited. In this work, we present highly efficient and reproducible Raman converters built with a NF immersed in ethanol (fig. 1, right). The converters are pumped at 532 nm in the sub-nanosecond regime and the first Stokes order photons of ethanol are generated at 630 nm in the evanescent field probing the liquid. The Raman conversion operating range limited by the damage threshold is optimized, leading to an external Raman conversion efficiency up to 60% with a NF radius of 300 nm and a length of 8 cm [4]. Results obtained with other liquids such as toluene and propanol will also be presented. In addition to opening the way for a new family of all-fibered compact Raman sources, these devices can be exploited for applications in Raman spectroscopy of liquids or gases.

References

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Figures

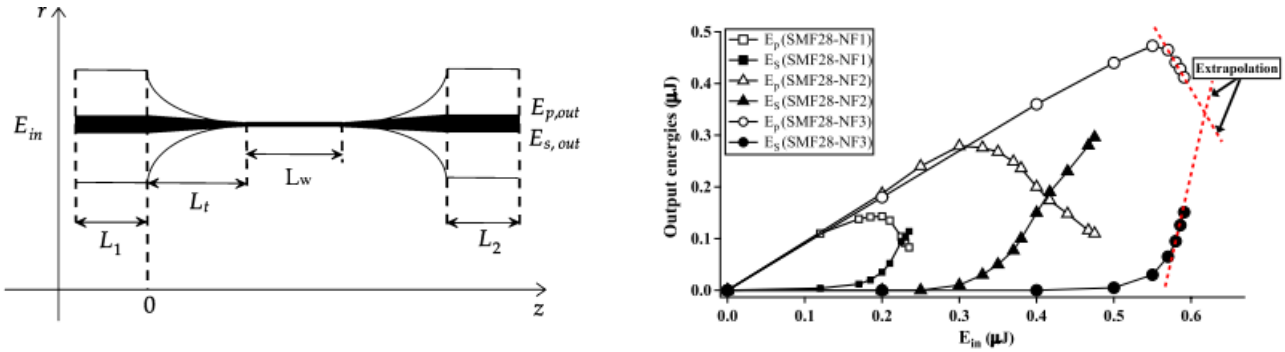

Figure 1: Left: Representation of a NF with its tapers. Right**:**Transmitted pump energy E_p at 532 nm and output Stokes energy E_s at 630 nm versus the laser incident energy E_{in} for three different nanofiber radii ρ: SMF28-NF1 (ρ=220 nm), SMF28-NF2 (ρ=300 nm) and SMF28-NF3 (ρ=350 nm).