Electronic Supplementary Information

Tuneable optical gain and broadband lasing driven in electrospun polymer fibers by high dye concentration

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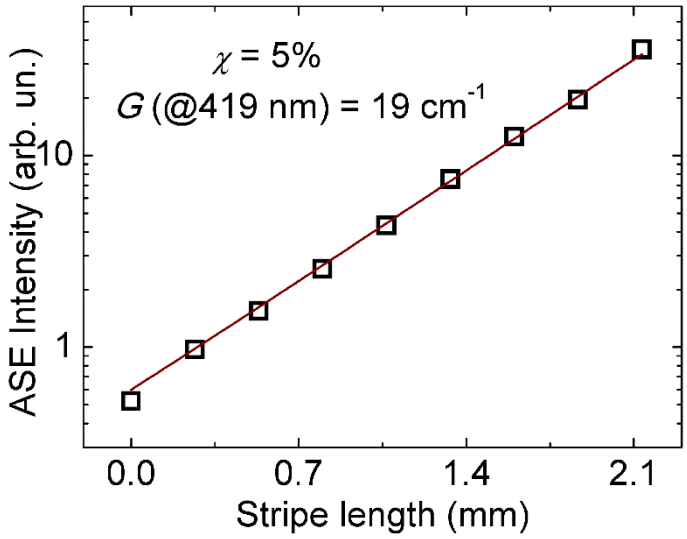

Figure S1. Dependence of the ASE intensity (χ = 5%, wavelength = 419 nm) on the excitation stripe length (squares) and corresponding best fit to the Eq. (1) (continuous line).

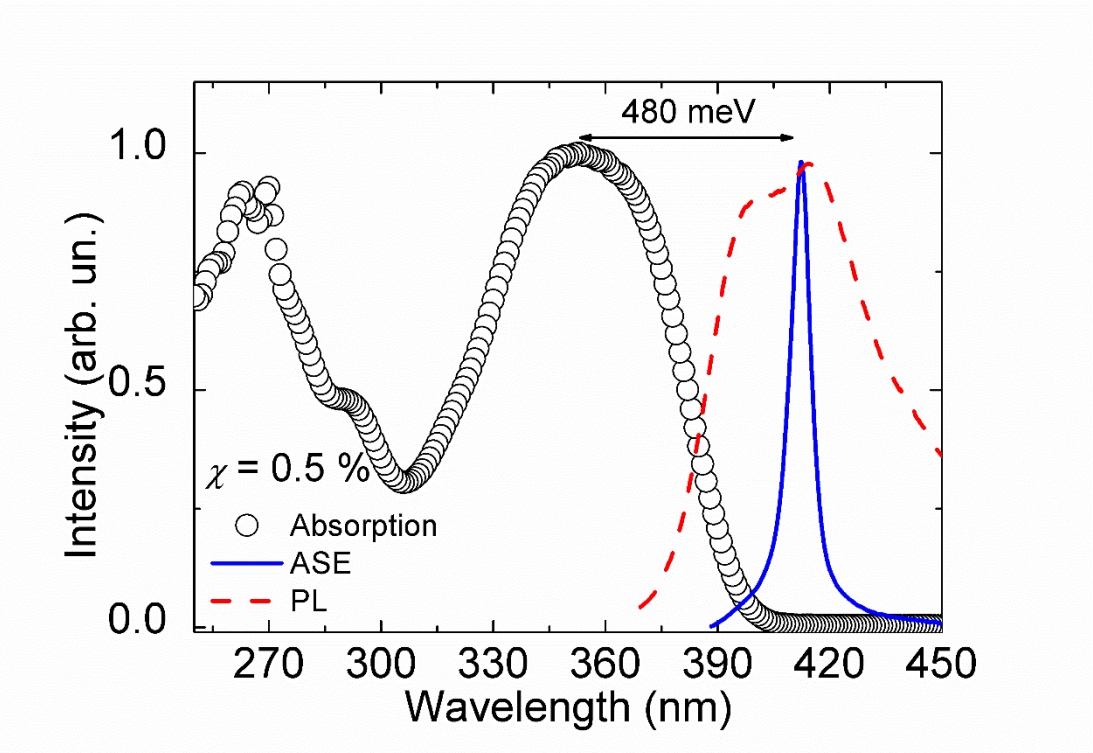

Figure S2. Normalized absorption (empty circles), photoluminescence (PL, red dashed line) and amplified spontaneous emission (ASE, blue continuous line) spectra of spin- coated films of FCF. The shift between the peak wavelengths of the absorption and ASE spectra is 480 meV.

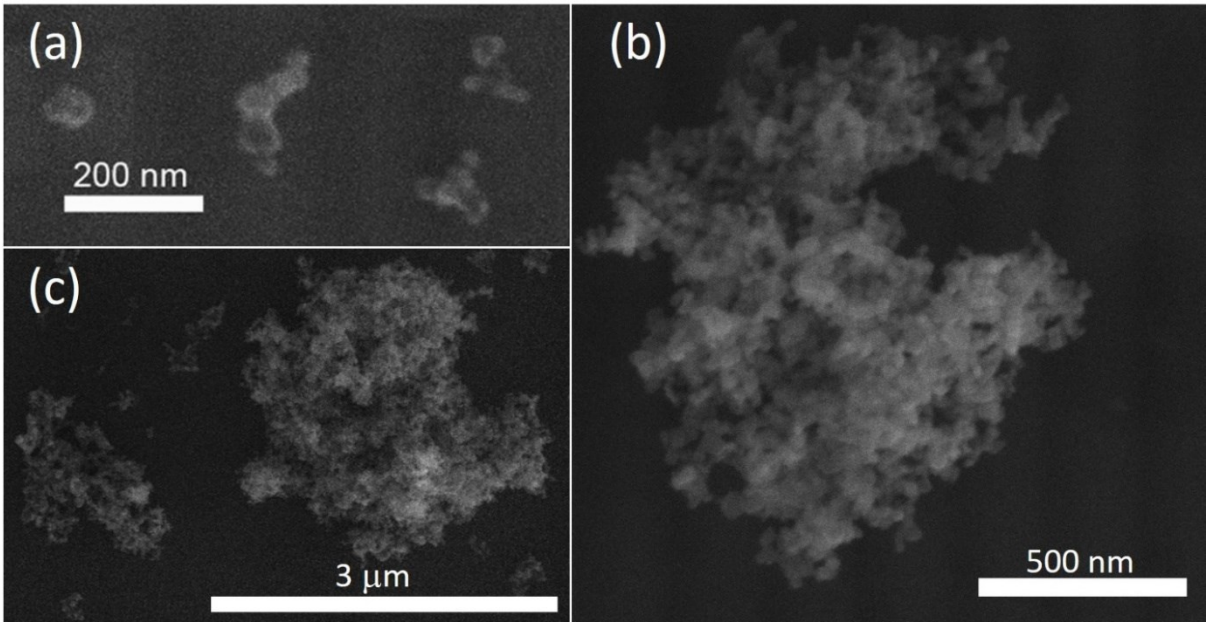

Figure S3. SEM micrographs of a few TiO_2 nanoparticles (a) and clusters (b,c).

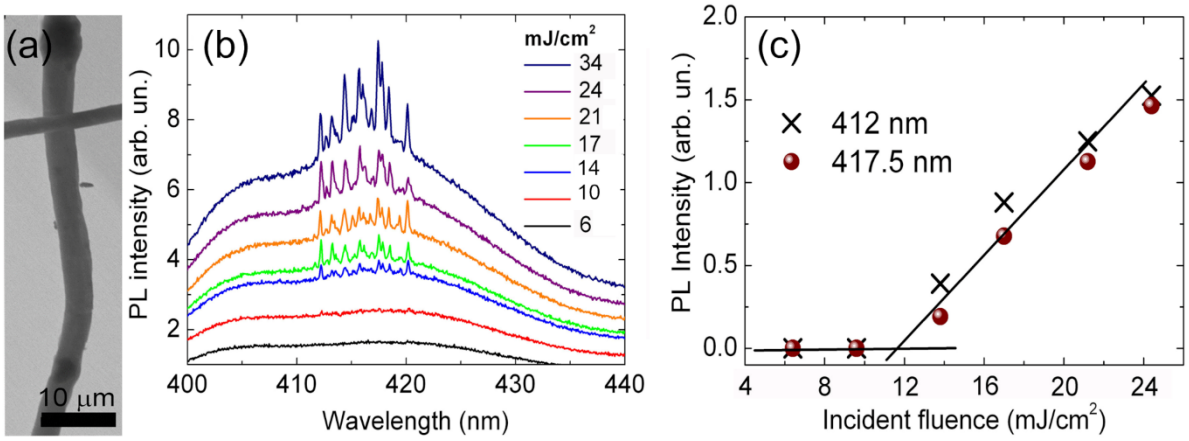

Figure S4. Morphological, compositional and RL analysis of randomly oriented fibers with χ = 5% and embedding TiO_2 nanoparticles. (a) Scanning transmission electron microscopy (STEM) micrographs of electrospun fibers doped with TiO_2. (b) Emission spectra measured at different incident fluences. (c) Plot of the emission intensity *vs*. incident fluence of two representative RL peaks.

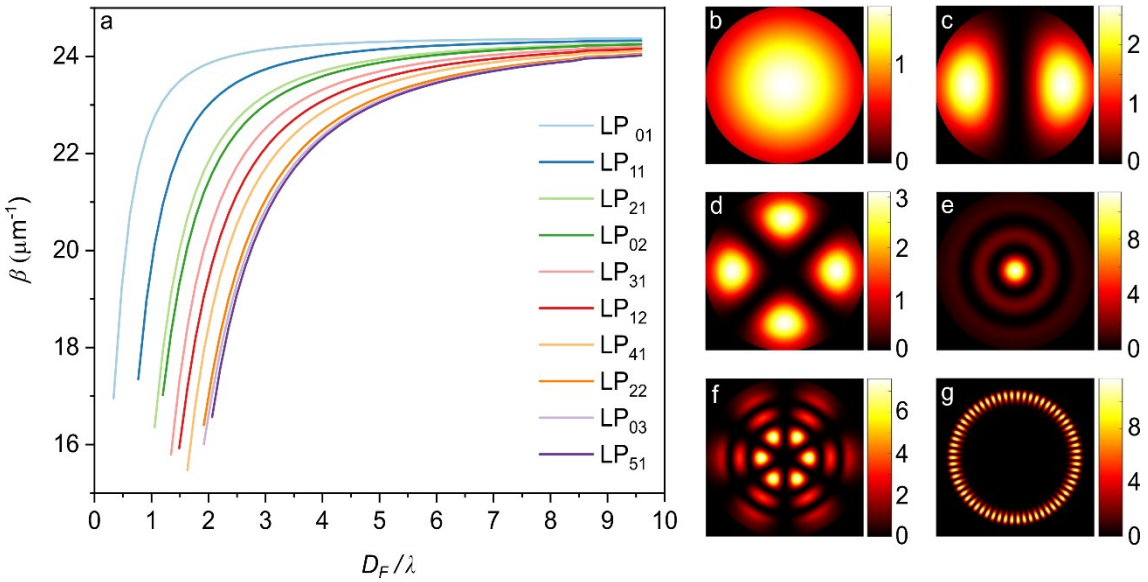

Figure S5. Calculated LP modes within a PS fiber. (a) Propagation constant, β, of the first ten LP modes as a function of the parameter D_F/λ, where D_F is the diameter of the fiber and λ = 417 nm (refractive index $n \cong 1.62$ [S1]). (b-g) Examples of intensity spatial profiles for mode (b) LP_{01}, (c) LP_{11}, (d) LP_{21}, (e) LP_{03}, (f) LP_{33} and (g) $LP_{31\,3}$. The values of β and the modes spatial profiles are calculated by using the package of Ref. [S2].

Table S1. Comparison of optical properties and dye concentration reported for various classes of doped polymer fibers (aligned systems).

Dye/polymer	Net gain (cm^{-1})	χ [a)]	λ_{em} [b)] (nm)	Reference
4- (dicyano-methylene)-2-tert-butyl-6(1,1,7,7-tetramethyljulolidyl-9- enyl)-4H- pyran /polystyrene	31.4	2%	605	[S3]
2,7-bis(9,9-diethylfluoren-2-yl)-9-(2-ethylhexyl)carbazole/polystyrene	24	2%	415	This work
4-(dicyanomethylene)-2-tert-butyl-6(1,1,7,7-tetramethyljulolidyl-9-enyl)-4H-pyran /polyvinylpyrrolidone	23.75	2%	670	[S4]
2-[2-[3-[[1,3-dihydro-1,1-dimethyl-3-(3-sulfopropyl)-2H-benz[e]indol-2-lidene]ethylidene]-2-[4-(ethoxycarbonyl)-1-piperazinyl]-1-cyclopenten-1-yl]ethenyl]-1,1-dimethyl-3-(3-sulfopropyl)-1H-benz[e]indolium hydroxide, inner salt, compound and N,N-diethylethanamine (1:1)/poly(methyl methacrylate)	7	0.5-1%	950	[S5]
2-[[2-[2-[4-(dimethylamino)phenyl]ethenyl]-6-methyl-4H-pyran-4-ylidene]methyl]-3-ethyl iodide/poly(methylmetacrylate)	5.5	0.16%	740	[S6]
4,4‴-bis[(2-butyloctyl)oxy]- 1,1′:4′,1″:4″,1‴-quaterphenyl/poly(methylmetacrylate)	5.4	1%	387	[S7]
5-chloro-2-[2- [3-[(5-chloro-3-ethyl-2(3H)-benzothiazol- ylidene)ethylidene]- 2-(diphenylamino)-1-cyclopenten-1-yl]ethenyl]-3-ethyl benzothiazolium perchlorate/ poly(methylmetacrylate)	4.2	0.5%	910	[S6]

[a)] (χ is expressed as the weight ratio between the incorporated dye and the polymer matrix).
[b)] (λ_{em} is the wavelength of net gain).

References:

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