ADVANCED MATERIALS

Supporting Information

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Thermalization of Fluorescent Protein Exciton–Polaritons at Room Temperature

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S.Satapathy, P. Deshmukh, F. Dirnberger, M. Khatoniar, Paul M. Molinaro, Ronald L. Koder, Vinod M. Menon
Department of Physics, Center for Discovery and Innovation, The City College of New York, 85 St. Nicholas Terrace, New York, NY 10031, USA.
E-mail: vmenon@ccny.cuny.edu

P. Deshmukh, M. Khatoniar, Vinod M. Menon
The PhD Program in Physics, The Graduate Center of the City University of New York, 365 5th Ave, New York, NY, 10016, USA.

B. Liu
Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, Michigan 48109, United States.

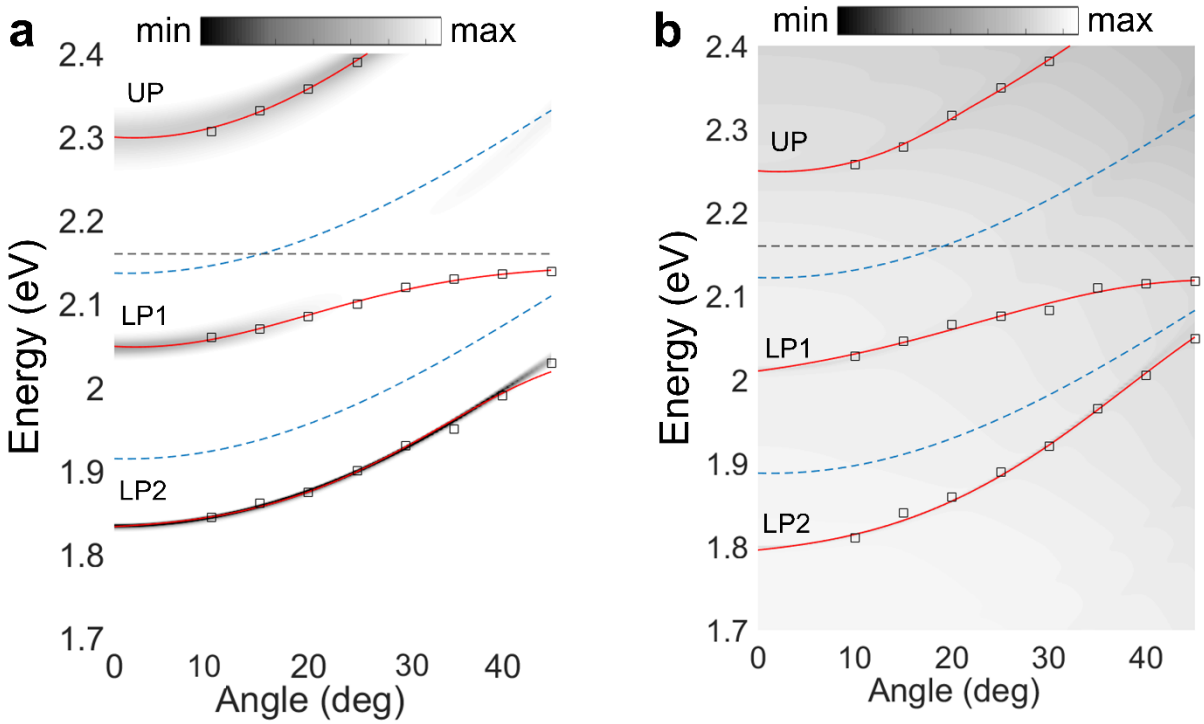

Figure S1. Angle-resolved white light reflectivity maps for **a)** LQ and **b)** HQ microcavity samples showing two lower polariton branches (LP1, LP2) and one upper polariton (UP) branch. Black rectangles denote the measured polariton dispersion, on top of the simulation results. The cavity and exciton modes are represented by gray dotted lines and white solid lines, respectively. The white light dispersion from the HQ cavity is weak in contrast due to the high reflectivity of the bottom DBR and top thick Ag. The exciton and cavity modes are represented by gray and blue dashed lines, respectively, while the polariton modes are represented by solid red lines.

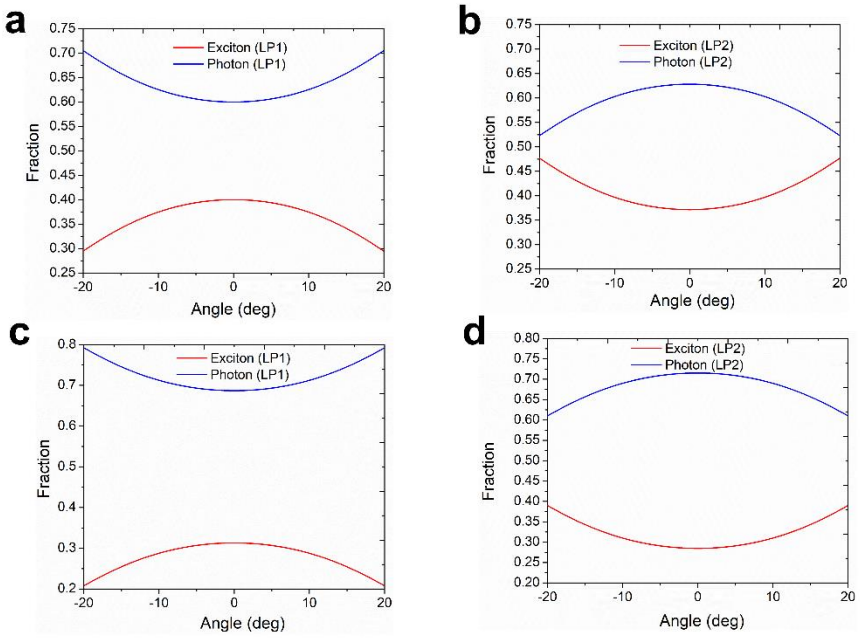

Figure S2. Extracted Hopfield coefficients for the lower polariton branches (LP1) and (LP2) for a), b) LQ and c), d) HQ cavity samples.

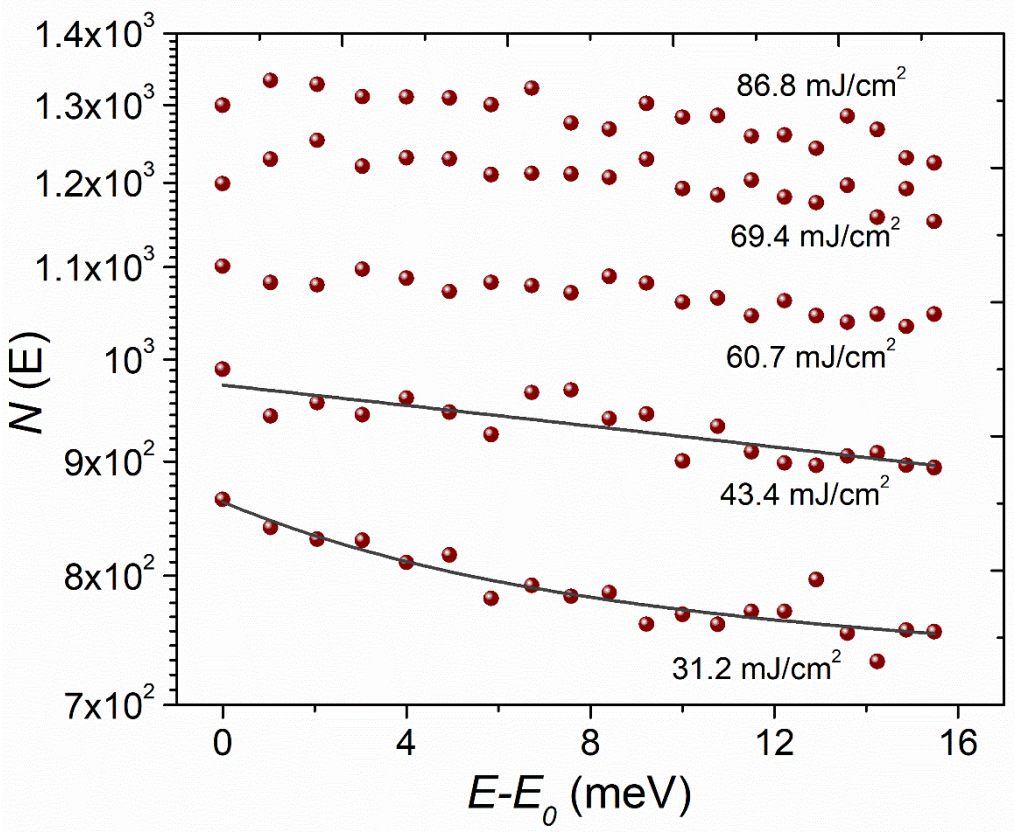

Figure S3. Energy distribution of polaritons at $k_{\parallel} = 0$ for the HQ cavity sample for excitation powers high above the threshold (the solid black lines denote the fits).

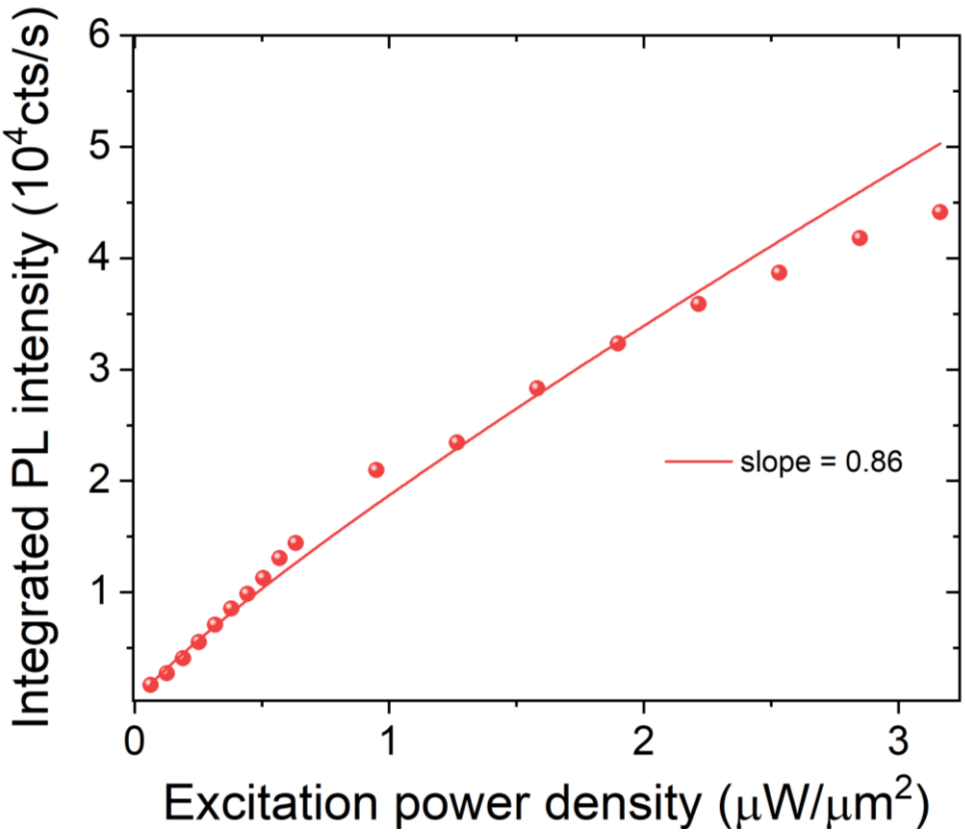

Figure S4. Power dependent sublinear photoluminescence response from a thin film of mScarlet upon pulsed laser (575 nm excitation, 78 MHz repetition rate) irradiation.

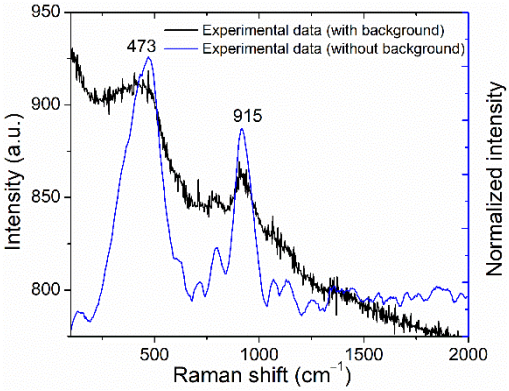

Figure S5. Raman spectra for a neat film of mScarlet before (black) and after background PL correction (blue).

Furthermore, stimulated scattering in organic microcavities has also been a consequence of direct vibronic (Raman mode) scattering from the exciton reservoir as a function of the exciton-polariton energy difference. [1,2,3] To verify this hypothesis, we measured the Raman spectra for the neat protein film, as shown in above. From the Raman spectra, we did not observe any significant high energy vibrational modes to be resonant with respect to the exciton-polariton energy difference along with the LP dispersion for any of the cavity samples. Hence, it is difficult to claim the hot exciton scattering mechanism [1] or Raman mode assisted decay for the scattering process. [2,3] Hence, we believe the scattering process in LP1 branch is majorly due to the Stokes-shift assisted radiative pumping mechanism.

References

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