Supplemental Materials: Switching off microcavity polariton condensate near the exceptional point

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The polariton dimer

We measure the dispersion curves of the planar microcavity and each potential well below the threshold. The potential depths of well 1 (Fig. S1(b)) and well 2 (Fig. S1(c)) are 1.46 and 1.30 mev compared with the planar microcavity (Fig. S1(a)), respectively.

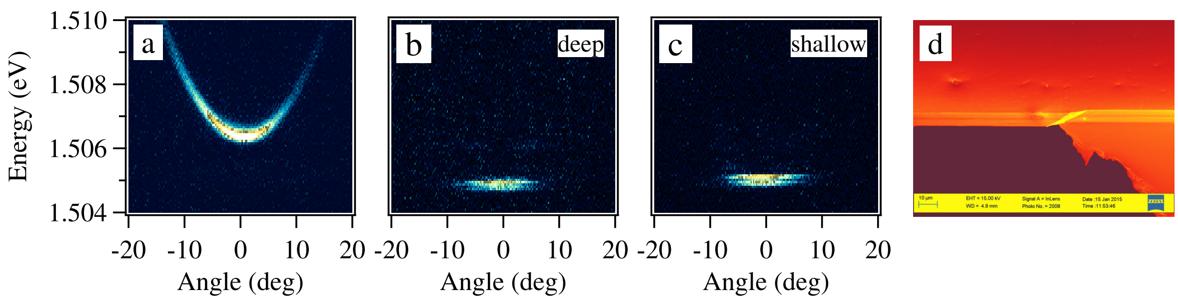

FIG. S1. **The planar microcavity and the polariton dimer.** The dispersion of the planar microcavity (a), the potential wells (b) 1 and (c) 2 below the threshold. (d) is the SEM of the microcavity.

The condensation of the polaritons under the asymmetric pumping

In the experiment, the wavelength of laser 1 is set to be around 750 nm and the spot size is around 2 μm to excite the potential well 1. As the power of laser 1 increases, the emission intensity of potential well 1 increases superlinearly at around 0.45 MW/cm^2 (Fig. S2(a)), the linewidth of the polaritons decreases greatly from 0.27 meV to 0.08 meV (see Fig. S2(b,c)) and the energy of polaritons is blueshifted. From these results we can estimate the threshold of the polaritons condensation is around 0.45 MW/cm^2. In addition, the polariton condensate is mainly localized at potential well 1 above the threshold (shown in Fig. 3(b)).

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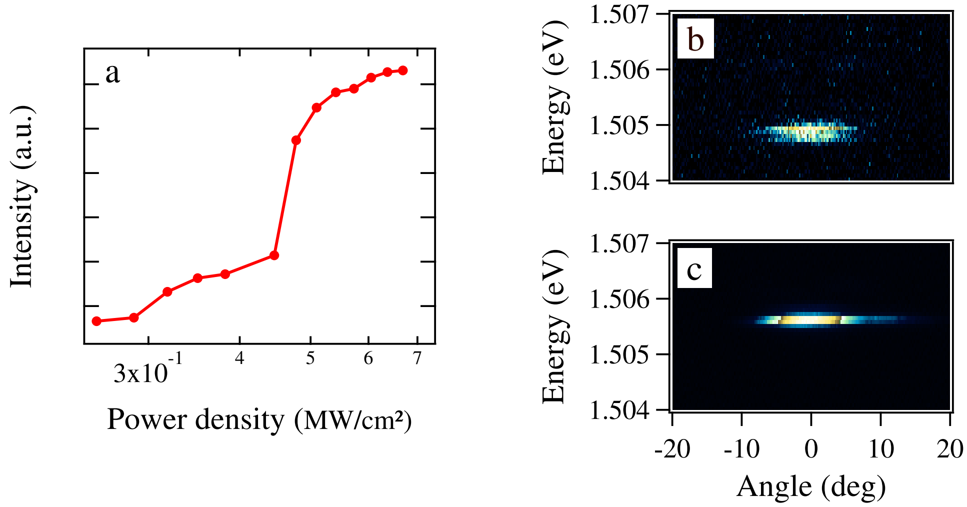

FIG. S2. **Demonstration of polariton condensation.** (a)The emission intensity of potential well 1 as a function of the pumping power. The dispersion of the polariton dimer below the threshold (b) and above the threshold (c).

The polariton dimer at the switching off regime

To check whether the system is below the polariton condensation threshold or not in the switching off region, we measure the dispersion of the polariton dimer when the power of the second laser is at around the switching off regime by increasing the exposure time to 500s. From Fig. S3, we can see that the linewidth (0.33 meV) of the polariton molecule is roughly the same as the one (0.27 meV) shown in Fig. S1(b). The emission intensity of the polariton dimer is drastically reduced at the switching off regime. All these show that the system is below the condensation threshold.

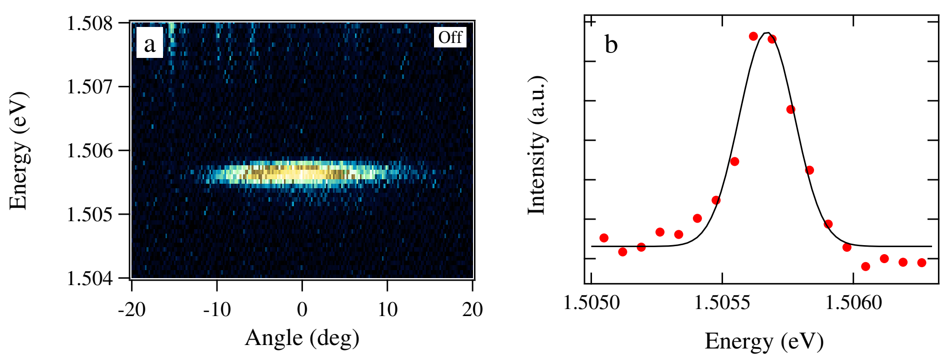

FIG. S3. **Switching off regime.** Dispersion of the polariton double-well potential when the system is at the switching off regime (a). The lineprofile is shown in (b). Exposure time: 500 s.

Energy levels of the polariton dimer versus the pump density of laser 2

Figure. S4 shows the dispersion taken at different pumping power of the laser 2. In these measurements, the deep potential well 1 is kept at around 1.2 P_{th}^{1} and the pumping power of the laser 2 is varied from 0 MW/cm^2 to 0.32 MW/cm^2. When the power intensity of the laser 2 is smaller than 0.032 MW/cm^2, the energy of the two modes share the same real part but different imaginary part (Fig. S4(a,b)). When the pumping power of the laser 2 is larger than 0.115 MW/cm^2, the real parts of the eigenenergy of the polariton dimer are repelled away but with the same imaginary components (Fig. S4(c-g)). Finally, we plot the optical spectra (Fig. S4(h,i)), extracted from Fig. S4(a,d), respectively.

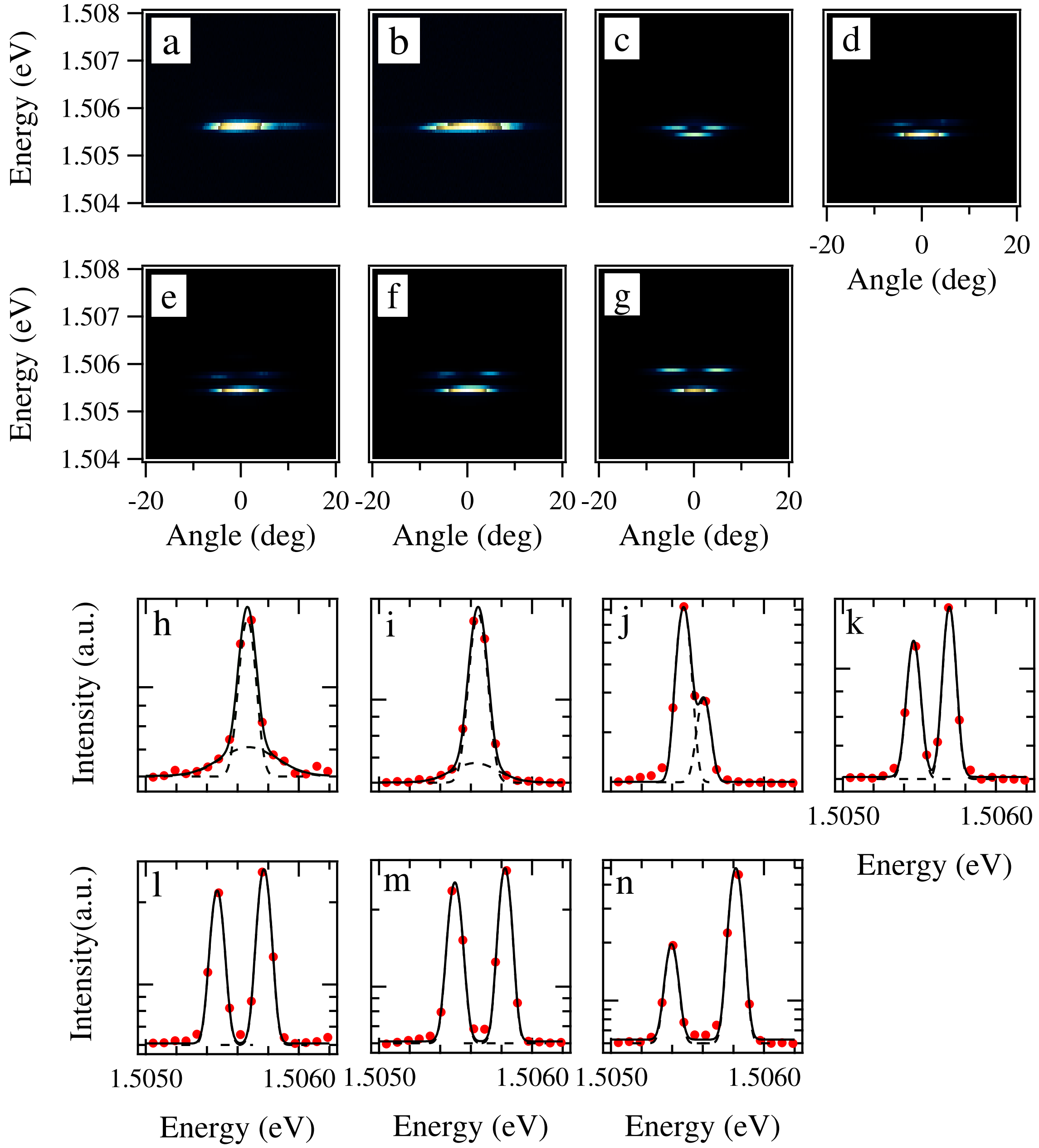

FIG. S4. **The dispersion corresponding to the Fig.4.** The energy of the two eigenmodes at different pumping density of laser 2. From (a) to (g), the pump power of laser 2 is 0 MW/cm^2, 0.032 MW/cm^2, 0.115 MW/cm^2, 0.143 MW/cm^2, 0.191 MW/cm^2, 0.255 MW/cm^2, 0.350 MW/cm^2 respectively. (h-n) are optical spectrum taken from (a-g), respectively. The solid lines are the fitting results, while the red dots are the experimental spectra.

Polariton double-wells under different pumping configurations

Here we show real-space imaging of the polariton double-wells under different pumping situations. In Fig. S5, where the potential well 1 is kept at $2P^1_{th}$, increasing the pump power of laser 2 weakens, but not completely shuts down the emission intensity of the dimer. The emission intensity of the polariton dimer is enhanced as the pumping power of laser 2 is further increased.

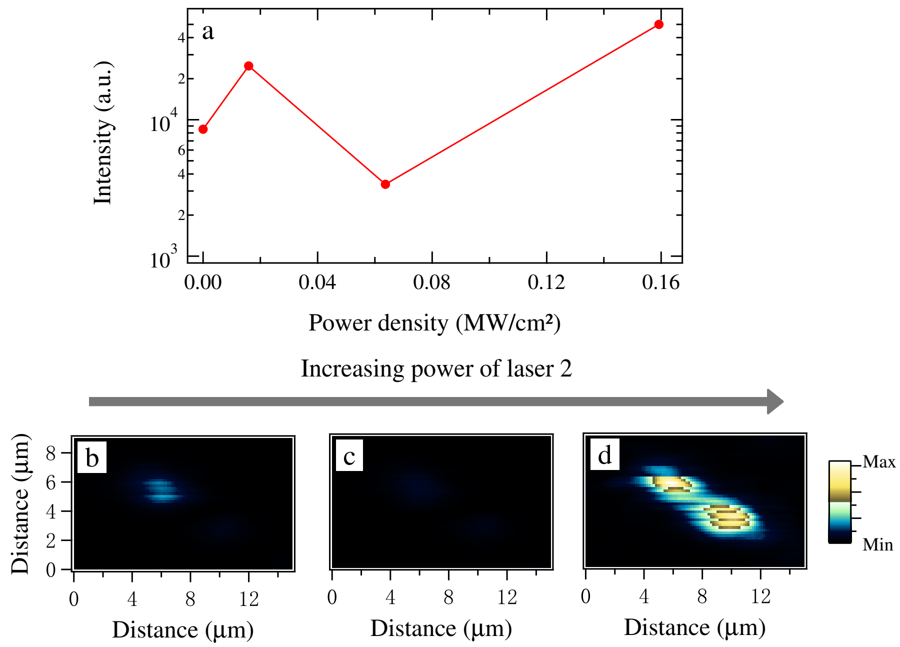

FIG. S5. **The weakening of the polariton dimer.** (a): The emission intensity of the polariton molecule versus the power of the pump 2. (b-d) The real-space distributions of the coupled wells at 0 MW/cm^2, 0.064 MW/cm^2, and 0.159 MW/cm^2 respectively.

In Fig. S6, the potential well 2 is kept at $1.2P_{th}^2$. When the pump power of laser 1 is increased to 0.032 MW/cm^2, the polariton dimer can also be switched off. As the pump power of laser 1 increases to 0.105 MW/cm^2, the polaritons condense again with symmetric pattern across the coupled wells.

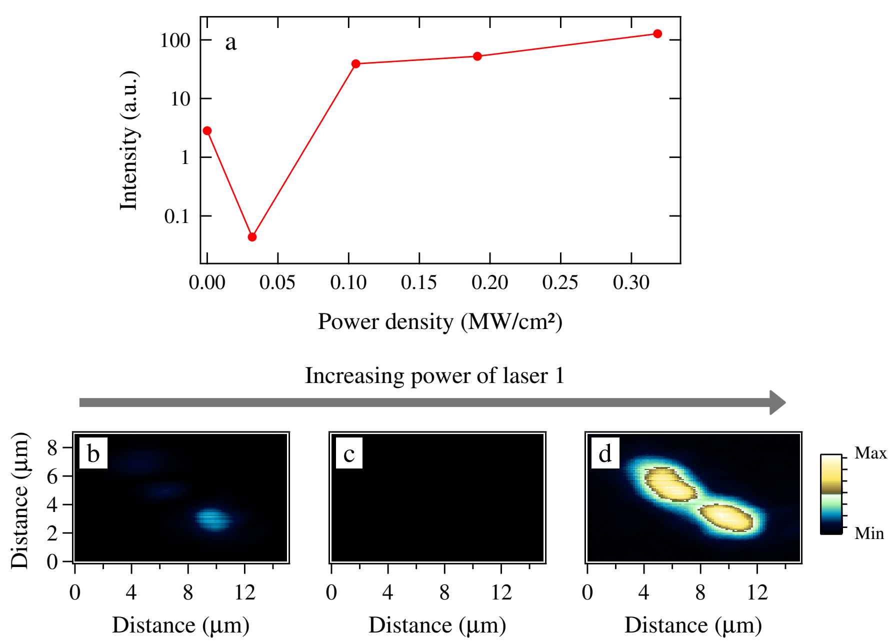

FIG. S6. **The switching off behavior when two potential wells are swapped.** (a) The emission intensity of the polariton molecule versus the power of the pump 1. (b-d) The real-space distributions of the emitted light at 0 MW/cm^2, 0.032 MW/cm^2, and 0.105 MW/cm^2 respectively.

In Fig. S7, a nearly uniform pump with the diameter around 40 μm is applied onto the polariton double-well potential. The condensed polaritons can not be switched off as the pumping power increases.

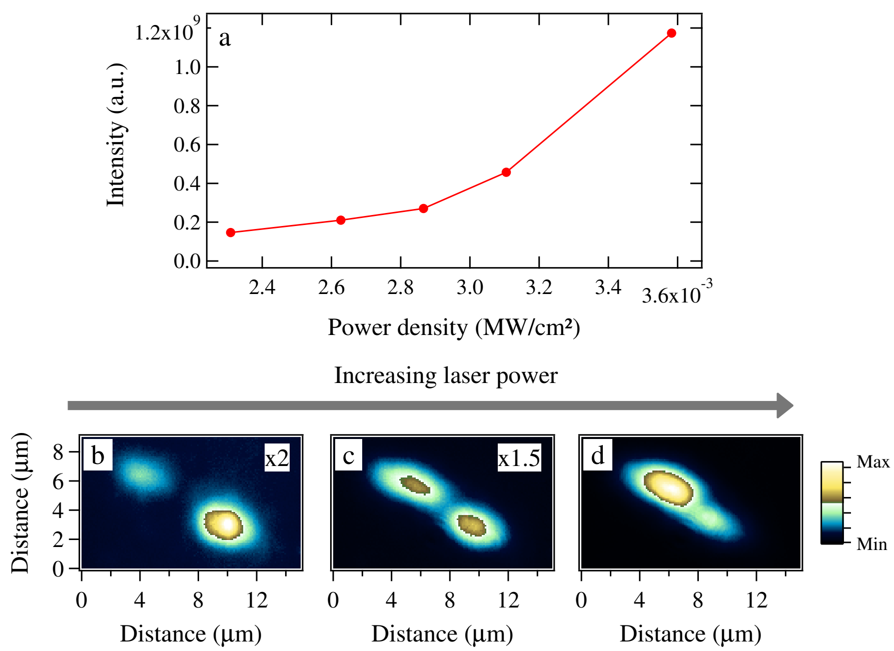

FIG. S7. **Symmetric pumping.** (a) The emission intensity of the polariton molecule as the function of the pump power. (b-d) The real-space distributions of the polaritons at 0.0023 MW/cm^2, 0.0026 MW/cm^2, and 0.0029 MW/cm^2 respectively.

Two-laser excitation in the planar region

We measured the emitted light of the polariton condensate produced by two lasers pumping in the planar area, away from the double-well potentials. As the laser 1 is fixed and the pumping power of the laser 2 increases, the polariton condensation can not be switched off.

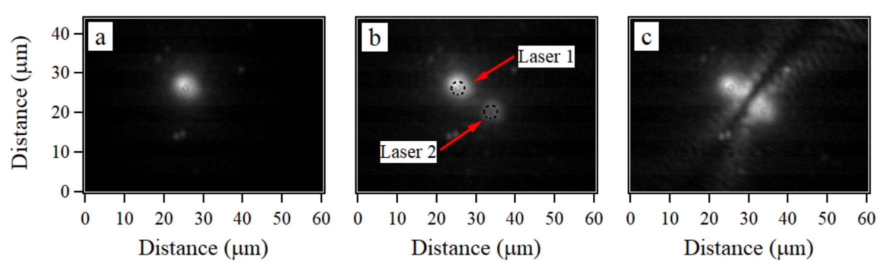

FIG. S8. **The results on the planar microcavity.** The emission intensity of the polariton molecule as the function of the pumping intensity of laser 2.