## Supplementary materials

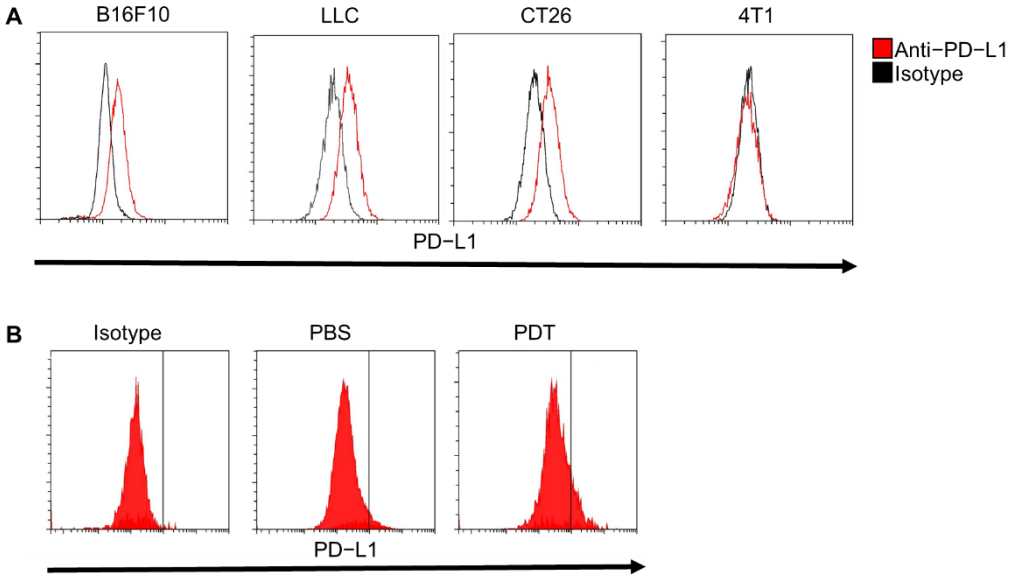



**Figure S1.** The representative histograms of PD−L1 expression. (A) The representative histograms of the result in Figure 2A. (B) The representative histograms of the result in Figure 2B.

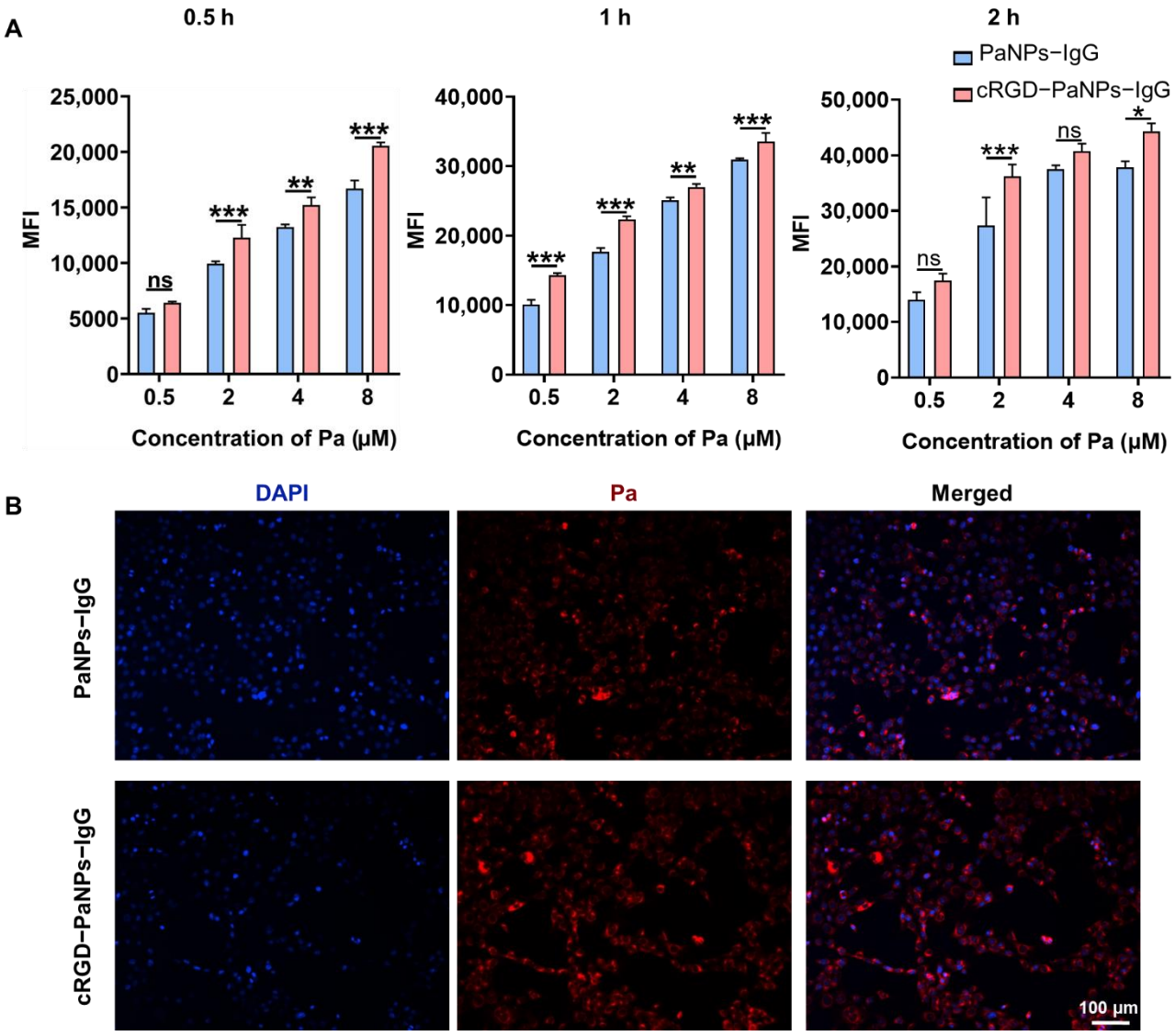



**Figure S2.** Cellular uptake of different PaNPs. (**A**) Quantitative analysis of cellular uptake measured by flow cytometry after incubation with different concentration of PaNPs−IgG or cRGD−PaNPs−IgG ($n$ = 3). (**B**) Fluorescence micrographs of 4T1 cells after the incubation with PaNPs−IgG or cRGD−PaNPs−IgG (4 μM of Pa) for 2 h. Data are presented as mean ± SD. *$P$<0.05, **$P$<0.01, ***$P$<0.001. ns, no significant difference between the two compared groups.

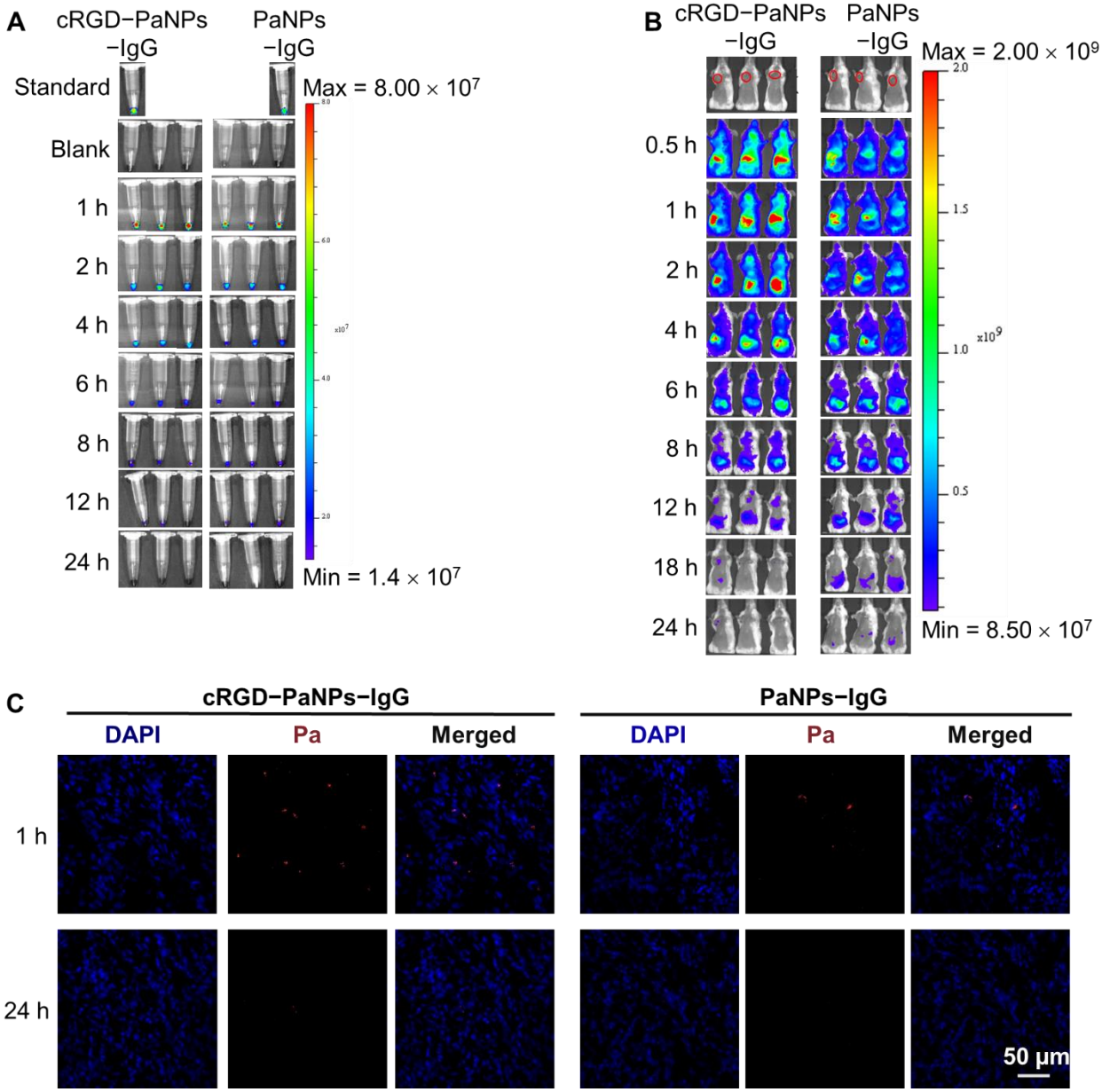



**Figure S3.** Pharmacokinetics and tumor distribution of Pa in BALB/c mice bearing 4T1 breast tumors. (**A**) Fluorescence images of the blood samples collected at different time points after i.v. injection of PaNPs−IgG or cRGD−PaNPs−IgG (5 mg/kg of Pa, 5 mg/kg of IgG). (**B**) Fluorescence images of the mice following the injection. (**C**) Confocal laser scanning micrographs of the tumor sections at 1 h or 24 h after the injection.

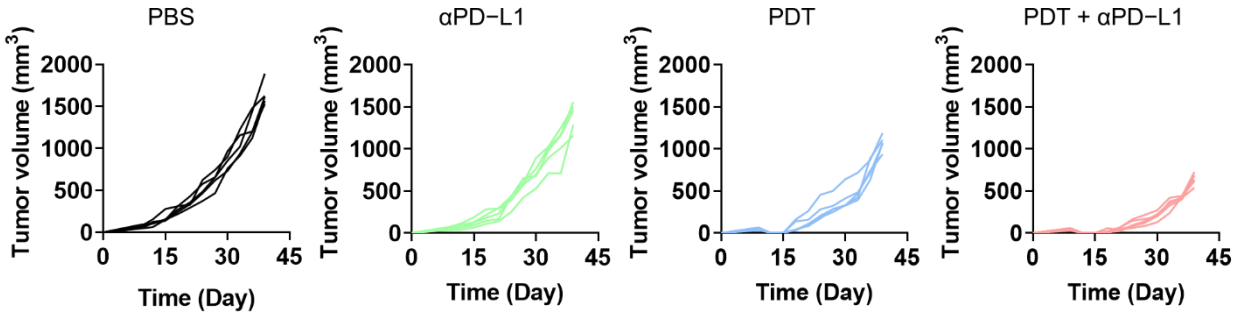



**Figure S4.** Individual tumor growth curves over time in each group of Figure 5B.

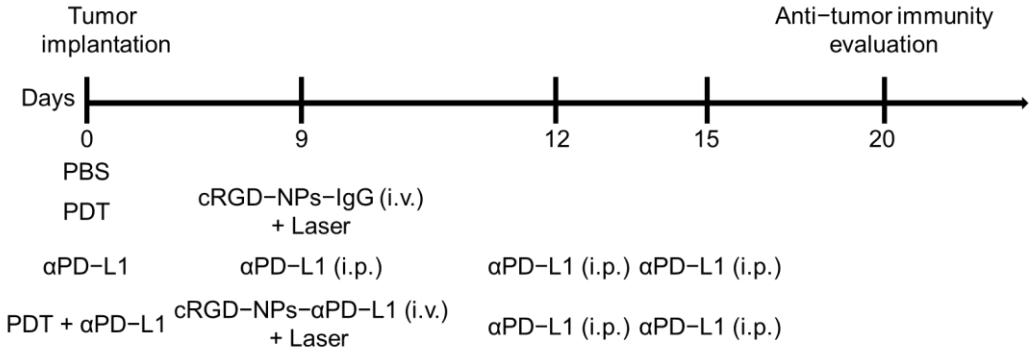



**Figure S5.** The regimens of different treatment for the evaluation of anti−tumor immunity in mice bearing 4T1 breast tumors. The tumors, spleens and draining lymph nodes (DLNs) were collected and evaluated from the four groups at 5 days after the last injection.

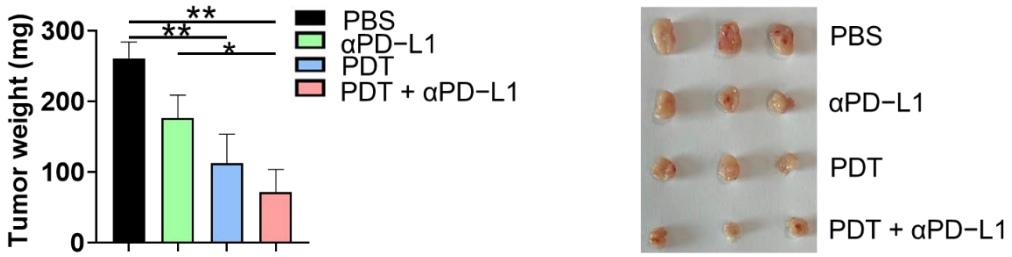



**Figure S6.** Tumor weights and the photographs of the tumors of BALB/c mice bearing 4T1 breast cancer following the various treatment ($n$ = 3). The treatment regimens were shown in Supplementary Figure S5. The tumors were collected, weighted and photographed at 5 days after the last treatment. Data are presented as mean ± SD. *$P$<0.05 and **$P$<0.01.

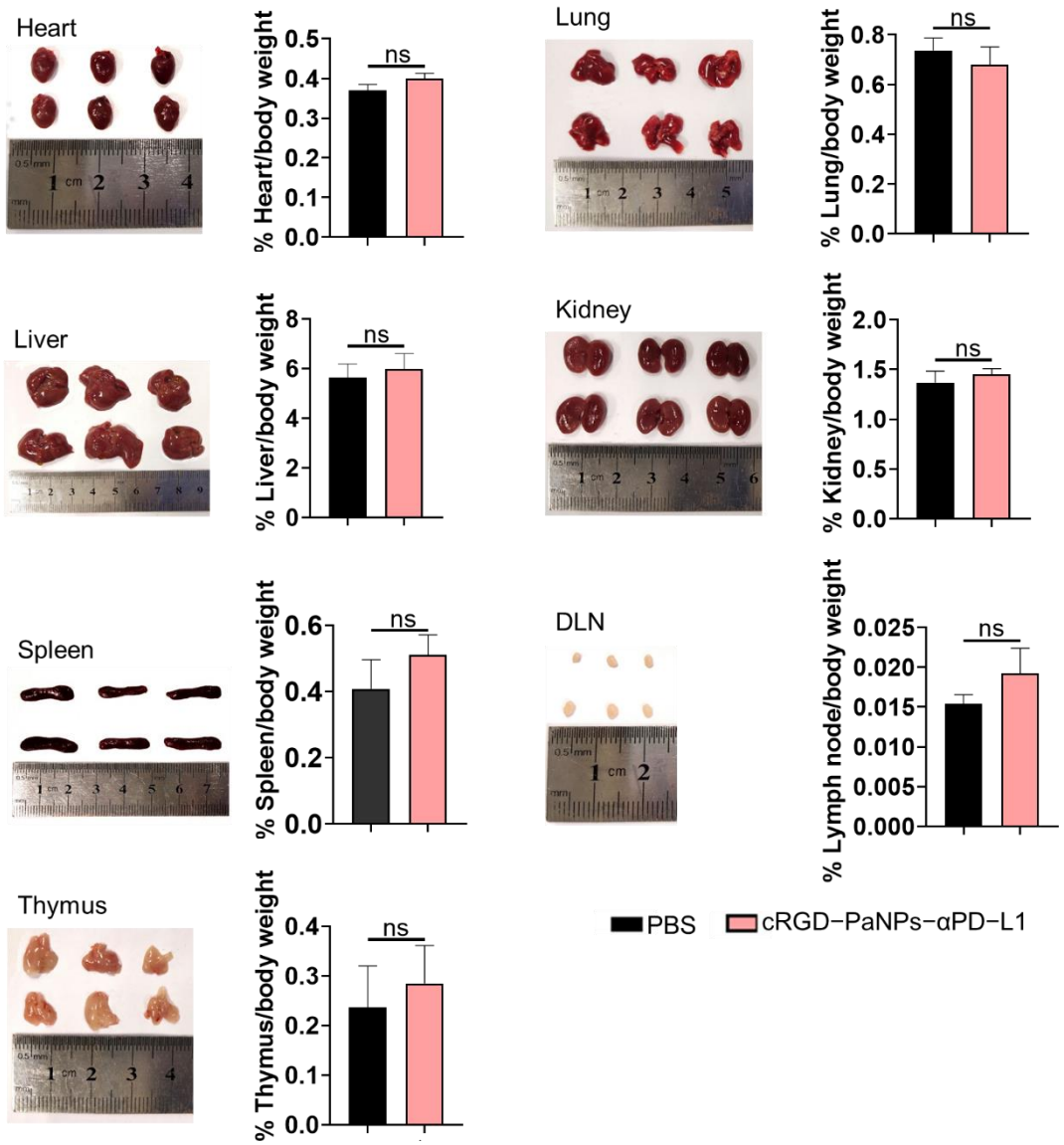



**Figure S7.** Photographs of the major organs and organ coefficients of mice at 28 days after i.v. injection of cRGD−PaNPs−αPD−L1 (5 mg/kg of Pa and 100 μg of αPD−L1) at days 0, 3 and 6. Mice treated with PBS solution were used as control ($n = 3$). Data are presented as mean ± SD. ns, no significant difference between the two compared groups.

**Table S1.** Size distribution, PDI and zeta potential of PaNPs−IgG or cRGD−PaNPs−IgG [a].

| | **PaNPs−IgG** | **cRGD−PaNPs−IgG** |
|---|---|---|
| Particle mean size (nm) | 173.70 ± 3.32 | 178.00 ± 3.89 |
| PDI | 0.19 ± 0.028 | 0.214 ± 0.06 |
| Zeta potential (mV) | −7.88 ± 0.046 | −10.20 ± 0.45 |

[a] Data are presented as mean ± SD ($n$ = 3).

**Table S2.** The drug loading efficiency and encapsulation efficiency of Pa and IgG in PaNPs−IgG [a].

| | **Pa** | **IgG** |
|---|---|---|
| Drug loading (%) | 1.63 ± 0.034 | 1.96 ± 0.031 |
| Encapsulation efficiency (%) | 85.07 ± 1.76 | 89.99 ± 1.48 |

[a] Data are presented as mean ± SD ($n$ = 3).

**Table S3.** The drug loading efficiency and encapsulation efficiency of Pa and IgG in cRGD−PaNPs−IgG [a].

| | **Pa** | **IgG** |
|---|---|---|
| Drug loading (%) | 1.40 ± 0.023 | 1.52 ± 0.0021 |
| Encapsulation efficiency (%) | 89.80 ± 1.45 | 88.03 ± 0.12 |

[a] Data are presented as mean ± SD ($n$ = 3).

**Table S4.** Blood chemistry and hematologic analysis of BALB/c mice [a].

| Items | Reference range | PBS | cRGD−PaNPs−αPD−L1 |
|---|---|---|---|
| WBC ($10^9$/L) | 5.69−14.84 | 6.23 ± 0.34 | 6.63 ± 0.69 |
| Lymph ($10^9$/L) | 3.6−11.56 | 4.03 ± 1.88 | 4.83 ± 1.30 |
| MONO ($10^9$/L) | 0.34−1.37 | 0.36 ± 0.09 | 0.43 ± 0.05 |
| NEUT ($10^9$/L) | 0.74−3.01 | 0.77 ± 0.05 | 2.30 ± 1.34 |
| LYMPH (%) | 55.06−83.82 | 76.87 ± 2.76 | 83.80 ± 3.14 |
| MONO (%) | 3.75−14.33 | 6.47 ± 1.54 | 9.30 ± 3.68 |
| NEUT% | 10.39−27.88 | 16.67 ± 1.27 | 12.17 ± 2.39 |
| RBC ($10^{12}$/L) | 8.16−11.69 | 9.83 ± 0.68 | 10.57 ± 0.42 |
| HGB (g/dL) | 12.4−18.9 | 15.93 ± 1.01 | 16.20 ± 0.51 |
| HCT (%) | 43.5−67.0 | 56.03 ± 2.94 | 57.50 ± 2.02 |
| MCV (fL) | 50.8−64.1 | 57.13 ± 2.94 | 54.43 ± 0.91 |
| MCH (pg) | 13.0−17.6 | 16.17 ± 0.24 | 15.30 ± 0.92 |
| MCHC (g/dL) | 23.9−33.1 | 28.37 ± 0.41 | 28.13 ± 0.12 |
| RDW (%) | 16.9−23.5 | 16.57 ± 0.46 | 17.50 ± 0.65 |
| PLT ($10^9$/L) | 476−1611 | 916.33 ± 73.83 | 1006.00 ± 74.26 |
| MPV (fL) | 4.6−5.8 | 5.80 ± 0.22 | 5.43 ± 0.17 |
| ALP (U/L) | 22.5−474.35 | 138.91 ± 9.11 | 131.12 ± 4.38 |
| AST (U/L) | 67−381 | 102.11 ± 11.58 | 100.77 ± 8.96 |
| BUN (mg/dL) | 7−31 | 2.28 ± 3.54 | 28.66 ± 1.04 |

[a] Blood chemistry and hematologic analysis of BALB/c mice at 28 days after i.v. injection of cRGD−PaNPs−αPD−L1 (5 mg/kg of Pa and 100 μg of αPD−L1) at days 0, 3 and 6. Mice treated with PBS solution were used as control ($n$ = 3). Reference range of hematology data of healthy female BALB/c mice were obtained from Charles River Laboratories: (http://www.criver.com/). Data are presented as mean ± SD.

**Table S5.** Antibodies used for flow cytometry experiments in this study.

| | Protein | Color | Clone | Item No. | Supplier |
|---|---|---|---|---|---|
| 1 | CD45 | Pe−Cy5 | 30−F11 | 15−0451−82 | eBioscience |
| 2 | CD8 | FITC | 53−6.7 | 11−0081−85 | eBioscience |
| 3 | IFN−γ | APC | XMG1.2 | 17−7311−82 | eBioscience |
| 4 | Rat IgG1 kappa | APC | eBRG1 | 17−4301−81 | eBioscience |
| 5 | Granzyme B | PE | NGZB | 12−8898−82 | eBioscience |
| 6 | Rat IgG2a kappa | PE | eBR2a | 12−4321−80 | eBioscience |
| 7 | CD11c | PerCP−Cy5.5 | N418 | 45−0114−82 | eBioscience |
| 8 | CD86 | FITC | GL1 | 11−0862−82 | eBioscience |
| 9 | MHC−II | APC | I−A/I−E | 17−5321−82 | eBioscience |
| 10 | CD3 | FITC | 145−2C11 | 11−0031−82 | eBioscience |
| 11 | CD25 | PE | PC61.5 | 12−0251−82 | eBioscience |
| 12 | CD4 | APC | GK1.5 | 17−0041−82 | eBioscience |
| 13 | Foxp3 | PerCP−Cy5.5 | FJK−16s | 45−5773−82 | eBioscience |
| 14 | PD−L1 | PE | MIH5 | 12−5982−81 | eBioscience |