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Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see Authors & Referees and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed
☐	☒ The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒ The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒ A description of all covariates tested
☐	☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒ For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐ Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Digital micrograph3.7, ZEN 2010, MestReNova 9.0.
Data analysis	Statistical analysis were performed on Graphpad Prism 7.0, flowcytometry data were analyzed on FlowJo software package (Flowjo V10). Young's moduli were extracted using MATLAB 12.0 software, Pearson's correlations were calculated using Image-pro Plus 6.0 software.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors/reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

The data that support the findings of this study are available within the paper and its supplementary Information files, or are available from the corresponding authors upon reasonable request. Source data are provided with this paper.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	No effect size was predetermined, but sample sizes employed in this study are consistent with previously published works (Li A W, Sobral M C, Badrinath S, et al. Nature materials, 2018, 17(6): 528-534; or Kuai R, Ochyl L J, Bahjat K S, et al. Nature materials, 2017, 16(4): 489-496.). For example, in vitro studies were repeated at least three times independently and in the in vivo experiments with 8-10 mice per group were performed.
Data exclusions	No animals and/or data were excluded.
Replication	All experiments were repeated for at least three times and experimental findings were reproducible.
Randomization	The dosing groups were filled by randomly selecting from the same pool of animals for in vivo experiments. Groups in all the in vitro and in vivo experiments were selected randomly.
Blinding	All the investigators were blinded to group allocation during data collection and analysis.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☐	☒ Antibodies
☐	☒ Eukaryotic cell lines
☒	☐ Palaeontology
☐	☒ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☐	☒ Flow cytometry
☒	☐ MRI-based neuroimaging

Antibodies

Antibodies used	Antibodies against mouse H-2Kb bound to SIINFEKL (anti-mouse H-2Kb bound to SIINFEKL, Cat. No. 141603), anti-CD45-Pacific blue (Cat. No. 103125), anti-CD3-PE (cat. No. 100312), anti-CD4-FITC (cat. No. 100510), anti-CD8-APC (cat. No. 100712), anti-CD44-PE/Cy7 (Cat. No. 103029), anti-CD62L-Percp-Cy5.5 (Cat. No. 104431), anti-PD-1-APC (Cat. No. 135209), anti-CD25-PE/cy7 (Cat. No. 101915), anti-CD80-APC (Cat. No.104713), anti-CD86-APC (Cat. No.105011) and anti-CD40-APC (Cat. No.124611) were purchased from Biolegend (San Diego, USA). anti-Foxp3-Percp-Cy5.5 (cat. No. 563902) was obtained from BD Pharmingen. PE-conjugated H-2Kb/OVA (SIINFEKL) tetramer (cat. no.TB-5001-1) was obtained from Medical & Biological Laboratories co., ltd (MBL). For all the flow experiments, antibodies were diluted for 200 times before use. Anti-PD-L1 (cat. No. BP0101) was obtained from BioXcell. Anti-PD-L1 antibody was diluted to 1mg/mL before injection to mouse.
Validation	All antibodies were verified by the supplier and each lot has been quality tested. All the antibodies used are from commercial sources and have been validated by the vendors. Validation data are available on the manufacturer's website. 1. nti-mouse H-2Kb bound to SIINFEKL antibody has been validated to be used for immunofluorescent staining with flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/pe-anti-mouse-h-2kb-bound-to-siinfekl-antibody-7247) 2. anti-CD45-Pacific blue antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/pacific-blue-anti-mouse-cd45-antibody-3102) 3. anti-CD3-PE antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/apc-anti-mouse-cd3epsilon-antibody-21) 4. anti-CD4-FITC antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/fitc-anti-mouse-cd4-antibody-480) 5. anti-CD8-APC antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/apc-anti-mouse-cd8a-antibody-150)

6. anti-CD44-PE/Cy7 antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/pe-cyanine7-anti-mouse-human-cd44-antibody-3932)
7. anti-CD62L-Percp-Cy5.5 antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/percp-cyanine5-5-anti-mouse-cd62l-antibody-4272)
8. anti-PD-1-APC antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/apc-anti-mouse-cd279-pd-1-antibody-6497)
9. anti-Foxp3-Percp-Cy5.5 antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.bdbiosciences.com/us/applications/research/t-cell-immunology/regulatory-t-cells/intracellular-markers/cell-signalling-and-transcription-factors/mouse/percp-cy55-rat-anti-mouse-foxp3-r16-715/p/563902)
10. anti-CD25-PE/cy7 antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.biolegend.com/en-us/products/pe-cyanine7-anti-mouse-cd25-antibody-13235)
11. PE-conjugated H-2Kb/OVA (SIINFEKL) tetramer antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.mblintl.com/products/tb-5001-1/)
12. Anti-PD-L1 antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse. (https://www.mblintl.com/assets/15.17.1.1-MHC-Class-I-Murine-Tetramer-PE-APC-BV_rev1909.pdf)
13. anti-CD80-APC antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse.(https://www.biolegend.com/en-us/products/apc-anti-mouse-cd80-antibody-2340)
14. anti-CD86-APC antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse.(https://www.biolegend.com/en-us/products/apc-anti-mouse-cd86-antibody-2896)
15. anti-CD40-APC antibody has been validated to be used flow cytometric analysis and mentioned species reactivity with mouse.(https://www.biolegend.com/en-us/products/apc-anti-mouse-cd40-antibody-4984)

Eukaryotic cell lines

Policy information about cell lines

Cell line source(s)	The TC-1, DC2.4, B16F10 and B16F10-OVA, NIH3T3, HUVEC cell lines were originally obtained from ATTC.
Authentication	A short tandem repeat DNA profiling method was used to authenticate the cell lines and the results were compared with reference database. Moreover, no mycoplasma contamination was detected in the above cell lines.
Mycoplasma contamination	All cell lines were tested for mycoplasma contamination. No mycoplasma contamination was found.
Commonly misidentified lines (See ICLAC register)	TC-1, B16F10-OVA, B16F10, DC2.4, NIH3T3 and HUVEC cell lines are not listed in the database.

Animals and other organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research

Laboratory animals	Female C57BL/6 mice with age of 6-8 weeks were purchased from Beijing Charles River Company (Beijing, China).OT-I and OT-II mice were obtained from Prof. Mingzhao Zhu (Institute of Biophysics, Chinese Academy of Sciences). NLRP3-/- mice on a C57BL/6 background with 7bp deficiency at the promoter region of Nlrp3 were donated by Prof. Huanhai Liu from Changzheng Hospital, Shanghai. Mice were housed in Specific-Pathogen Free animal facility in ambient temperature (22±2 °C), air humidity 40%–70% and 12 h dark/12 h light cycle.
Wild animals	No wild animal was used in this study.
Field-collected samples	The study did not involve samples collected from field.
Ethics oversight	All animal experiment protocols were reviewed and approved by the Animal Care and Use Committee of Institute of Process Engineering, Chinese Academy of Sciences and complied with all relevant ethical regulations.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Flow Cytometry

Plots

Confirm that:

☒ The axis labels state the marker and fluorochrome used (e.g. CD4-FITC).

☒ The axis scales are clearly visible. Include numbers along axes only for bottom left plot of group (a 'group' is an analysis of identical markers).

☒ All plots are contour plots with outliers or pseudocolor plots.

☒ A numerical value for number of cells or percentage (with statistics) is provided.

Methodology

Sample preparation	For tumour samples, they were chemically disruption and filtered through a 40 μM strainer. Then the suspensions were

Sample preparation	incubated with ammonium chloride buffer for erythocyte lysis and washed with PBS. Single-cell suspensions were obtained and stained with antibodies according to the manufacturer's protocols, and then analyzed by flow cytometry.
Instrument	BD LSR II, BD Accuri C6, BDFACS Aria
Software	FlowJo software package (Flowjo V10)
Cell population abundance	The absolute cells around 8000-10000 were analyzed for fluorescent intensity in the defined gate.
Gating strategy	In general, cells were first gated on FSC/SSC. Singlet cells were gated using FSC-H and FSC-A. Dead cells were then excluded and further surface and intracellular antigen gating was performed on the live cell population (Supplementary Figure 33).

☒ Tick this box to confirm that a figure exemplifying the gating strategy is provided in the Supplementary Information.