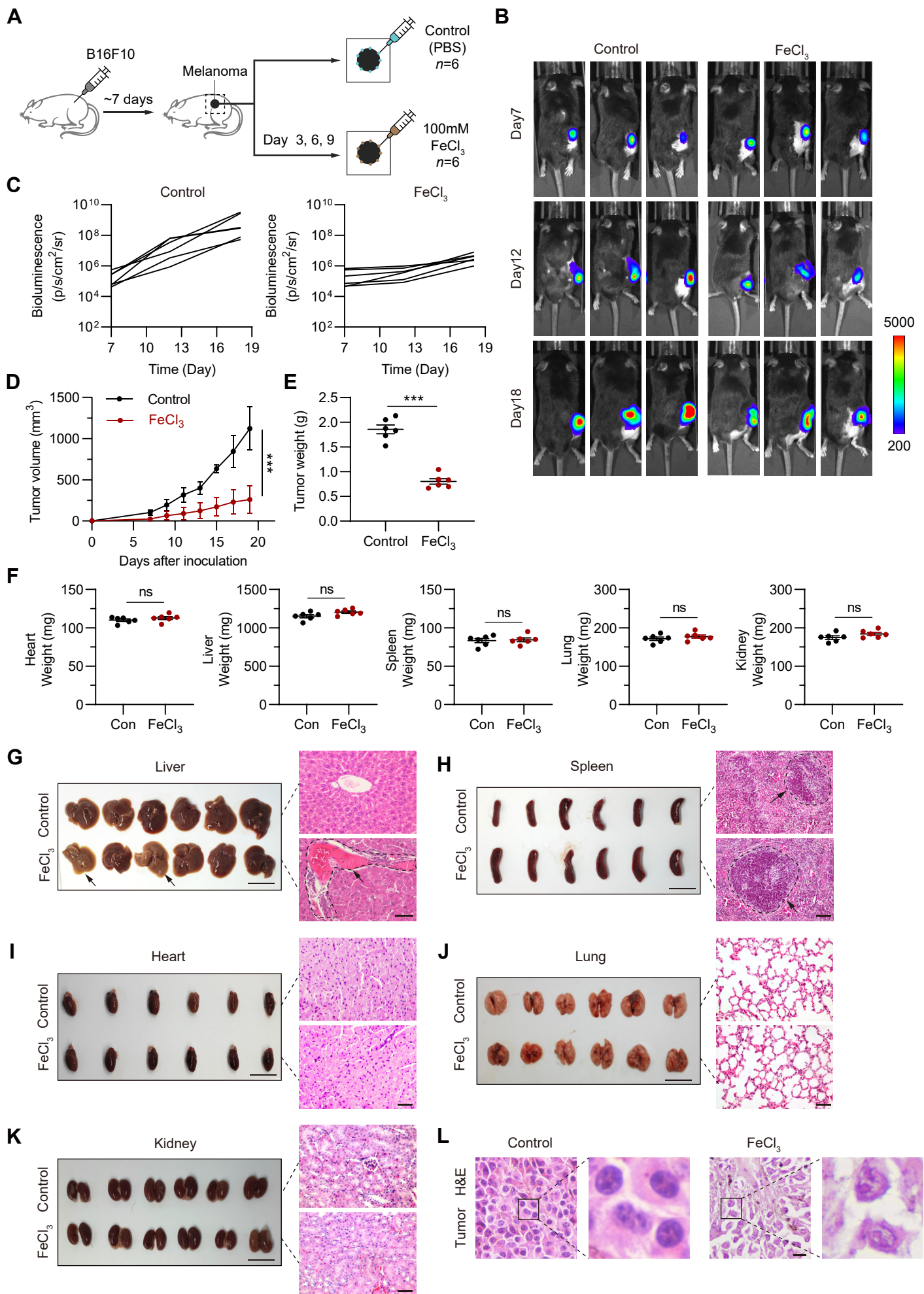


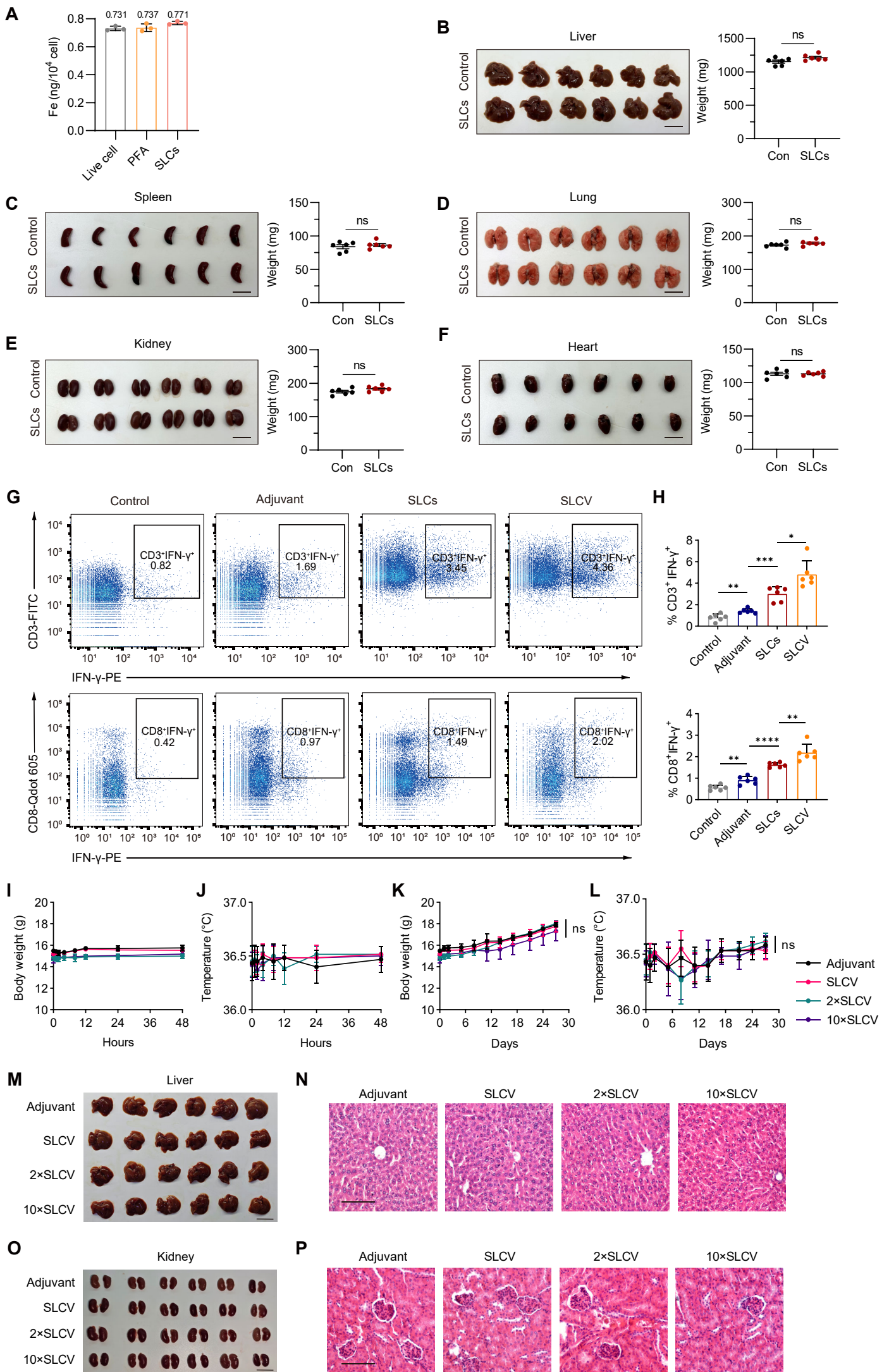
**Figure S1. SLCs have no cell viability and tumorigenic ability, related to Figure 1.**

(A) Representative images of different concentrations of FeCl<sub>3</sub> in PBS, DMEM and DMEM+PBS solutions, and (B) statistics of absorbance intensities measured at  $\lambda=561$  nm (n=3). (C) Representative brightfield (top) and phase contrast (middle) microscopy images of A549, MCF-7, HCT-116 and HUVEC cells treated with PBS, 4% paraformaldehyde, or 100 mM FeCl<sub>3</sub>. The red dashed box represents a magnified view of the phase contrast microscopy image. Scale bar, 5  $\mu$ m. (D) Representative phase contrast microscopy images of PLC-PRF-5 cells treated with 100 mM metal salts including FeCl<sub>3</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, FeCl<sub>2</sub>, CuCl<sub>2</sub>, AlCl<sub>3</sub>, ZnCl<sub>2</sub>. (E) TEM imaging of ultrathin sections of B16F10 normal and FeCl<sub>3</sub>-treated cells. Scale bar, 5  $\mu$ m. (F) Coomassie brilliant blue staining of total protein content of PLC-PRF-5 living cells and cells treated with FeCl<sub>3</sub>, and (G) DAPI staining and immunofluorescence staining of  $\beta$ -Tubulin, GAPDH and VEGFR-2. Scale bar, 10  $\mu$ m. (H) Scatter plot of protein expression correlation between B16F10 normal and FeCl<sub>3</sub>-treated cells. (I) Volcano plot displaying protein expression changes between B16F10 normal and FeCl<sub>3</sub>-treated cells. (J) Heatmap and hierarchical clustering analysis of programmed cell death biomarkers in proteomics. (K) Annexin V-PI flow cytometric analysis of PLC-PRF-5 live cells and cells treated with FeCl<sub>3</sub>. (L) Quantification of the wound healing assay in PLC-PRF-5 live cells or cells treated with FeCl<sub>3</sub> for 0, 12, 24, and 48 hours. (M) Fluorescent gelatin degradation and phalloidin/DAPI staining of PLC-PRF-5 live cells or cells treated with FeCl<sub>3</sub>. Quantification of relative fluorescent gelatin degradation is shown in the right panel. Scale bar, 30  $\mu$ m. (N-O) Representative tumor image, scale bar, 5  $\mu$ m. Tumor weight (O) of subcutaneous B16F10 implants in mice as in Fig S1N. (P) Western blotting was performed to detect apoptotic markers (Cleaved Caspase-3, PARP1). The apoptosis inducer Staurosporine treated cells were detected as a positive control. (Q) Western blotting was performed to detect necroptosis marker (pMLKL), and ferroptosis markers (GPX4 and xCT). The middle lane represents the positive controls for each death pathway: TNF- $\alpha$  (20 ng/ml), 100 nM Sm-164, and 20  $\mu$ M Z-VAD-FMK induce necroptosis. Erastin (5  $\mu$ M) induces ferroptosis. Data represent analyses of the indicated n mice per group, means  $\pm$  S.D, and were analyzed by two-tailed unpaired t tests with GraphPad Prism software. \*\*\*\*P < 0.0001.



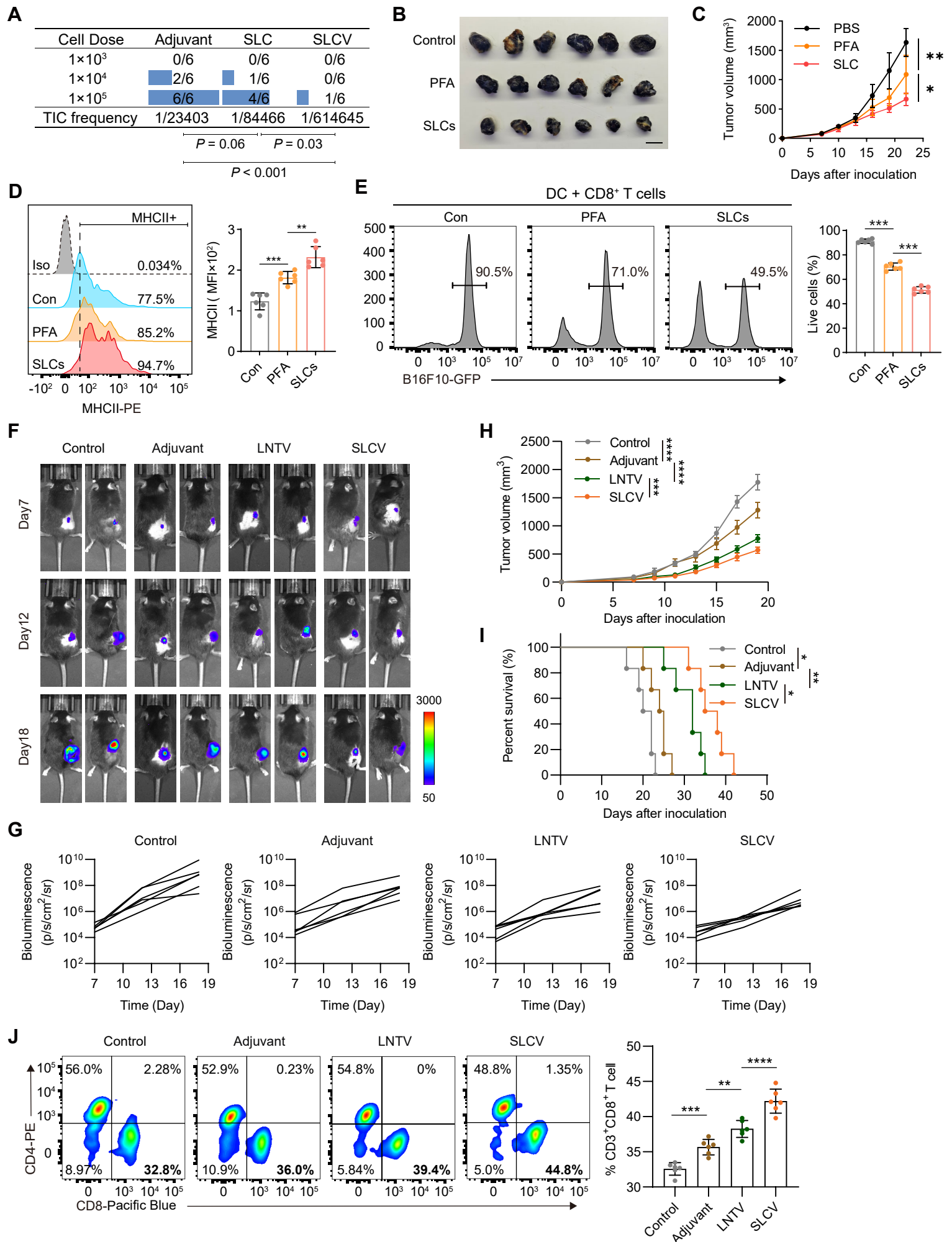
**Figure S2. Intratumoral injection of high concentration FeCl<sub>3</sub> can limit tumor growth, but needs to be improved, related to Figure 2.**

**(A)** Schematic showing model construction and in situ tumor injection of FeCl<sub>3</sub>. C57BL/6 mice received subcutaneous injections of B16F10-luciferase cells on day 0. After seven days of tumor formation, 100 mM FeCl<sub>3</sub> was injected in situ at multiple points around the tumor every 3 days for a total of 3 injections, and intratumoral injection of PBS served as a control group. The mice were sacrificed on day 19, and the tumor tissues and organs of the mice were collected. **(B-C)** Representative bioluminescence images **(B)** and quantitative bioluminescence **(C)** of mice in different treatment groups (n=6). **(D)** Tumor volumes were recorded every two days until day 19 (n = 6). **(E)** Tumor weight was measured on day 19 (n = 6). **(F)** Hearts, livers, spleens, lungs and kidneys were removed and organ weights were recorded on day 19 (n = 6). **(G-K)** Representative images of livers, spleens, hearts, Lungs and Kidneys (Scale bar, 1 cm) collected on day 19 and HE staining of sections (Scale bar, 100 μm). **(L)** HE staining of tumor tissue. Scale bar, 50 μm. Data represent analyses of the indicated n mice per group, means ± S.D, and were analyzed by two-tailed unpaired t tests with GraphPad Prism software. ns, not significant, P > 0.05; \*\*\* P < 0.001.



**Figure S3. The treatment with SLCs or SLCV had no detectable toxicity in mice, related to Figures 2 and 4.**

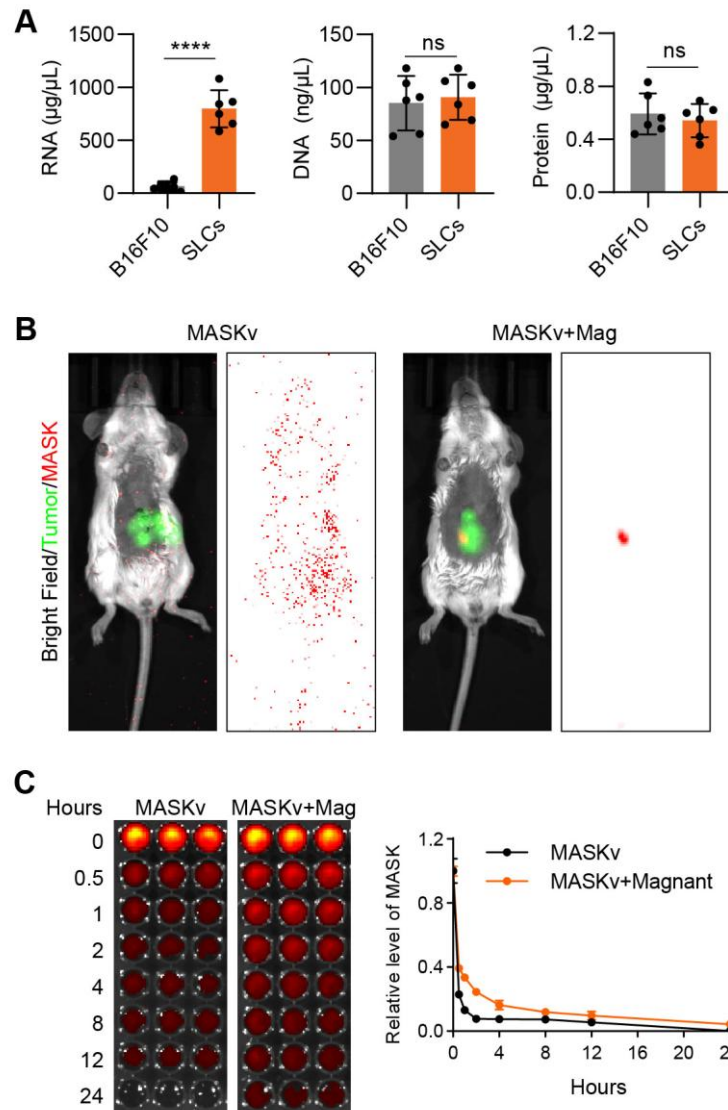
**(A)** Measurement of iron content in B16F10 live cells, B16F10 cells fixed with paraformaldehyde (PFA), and SLC derived from B16F10 cells treated with ferric chloride. **(B-F)** On day 19, Livers **(B)**, Spleens **(C)**, Lungs **(D)**, Kidneys **(E)** and Hearts **(F)** were removed (Scale bar, 1 cm) and organ weights were recorded (n=6). Data represent analyses of the indicated n mice per group, means  $\pm$  S.D, and were analyzed by two-tailed unpaired t tests with GraphPad Prism software. ns, not significant,  $P > 0.05$ . **(G-H)** Flow cytometric quantification of tumor antigen-specific T cell subsets in different treatment group. **(G)** Representative flow cytometry plots of CD3<sup>+</sup>IFN- $\gamma$ <sup>+</sup> and CD8<sup>+</sup>IFN- $\gamma$ <sup>+</sup> T cells in Control, Adjuvant, SLCs, and SLCV groups. Numerical values indicate the percentage of positive cells within respective gates. **(H)** Bar graphs summarizing the frequencies of CD3<sup>+</sup>IFN- $\gamma$ <sup>+</sup> and CD8<sup>+</sup>IFN- $\gamma$ <sup>+</sup> T cell subsets. Data are presented as mean $\pm$ SEM; significance was determined by two-tailed unpaired t tests with GraphPad Prism software. \*\*\*\* $P < 0.0001$ . **(I-J)** Acute toxicity (24h) experiments for SLCV. We administered PBS, 1x, 2x, and 10x doses of SLCV to mice and monitored changes in body weight **(I)**, body temperature **(J)**, and behavior within 24 hours. **(K-L)** Long-term toxicity (30d) experiments for SLCV. The PBS, 1x, and 2x dose groups received SLCV every three days, while the 10x dose group did not receive additional doses after the initial administration. Changes in body weight **(K)**, body temperature **(L)**, and behavior were monitored. **(M-P)** After 30 days, the liver **(M)** and kidneys **(O)**, revealed no significant abnormalities (Scale bar, 1 cm), and HE staining (Scale bar: 50  $\mu$ m) showed no apparent pathological changes in liver **(N)** and kidneys **(P)** the SLCV-treated groups.



**Figure S4. Immunotherapy for SLC vaccine is more effective compared to PFA treated cell and LNT vaccine, related to Figure 4.**

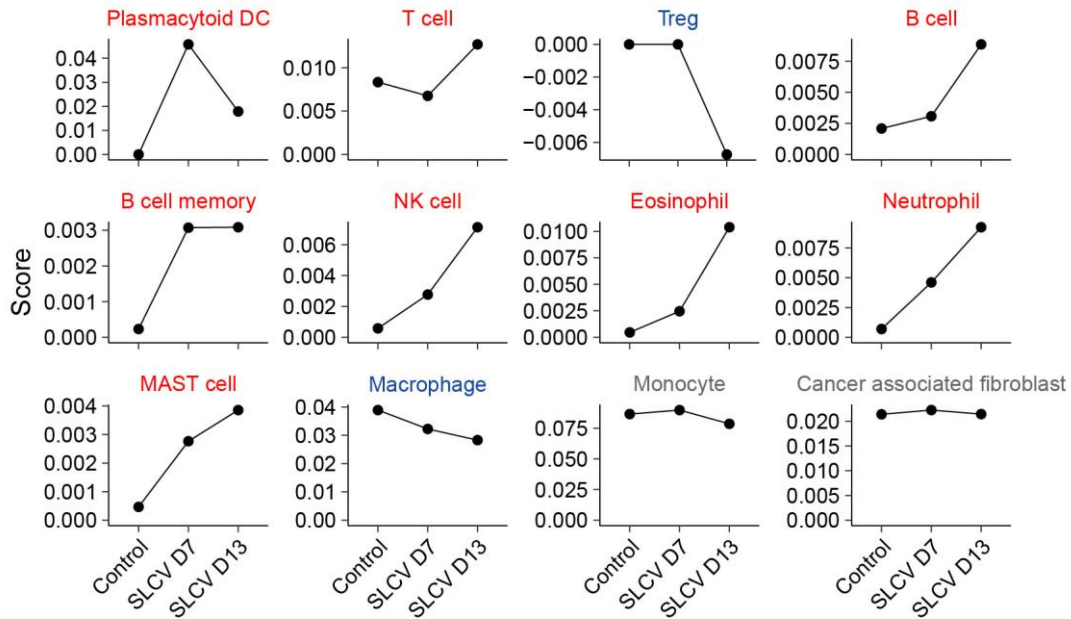
**(A)** The tumor-initiating capacity of the cells was assessed using extreme limiting dilution analysis (ELDA). The frequency of B16F0 tumor-initiating cells (TIC) was calculated for the adjuvant, SLC, and SLCV treatment groups. Biological replicates, n=6. The Chi-square test was used to determine the P value. **(B)** Tumor image in different treatment groups. Scale bar: 1 cm. **(C)** Tumor volumes were recorded every three days until day 22 (n=6). **(D)** Flow cytometric detection of untreated DCs or DCs treated with SLCs in vitro, representative flow cytometry images (left) and mean fluorescent intensity (MFI) (right) of DCs mature differentiation marker MHCII. **(E)** CD8<sup>+</sup> T cells isolated from the spleens of C57BL/6 mice were mixed with BMDCs at a 2:1 ratio and incubated with B16F10-GFP cells, with indicated cells for 24 h. B16F10-GFP cell viability was analyzed by flow cytometry. **(F-G)** Representative bioluminescence images **(F)** and quantitative bioluminescence **(G)** of mice after treatment with PBS, adjuvant (MPLA, 20 ug/mouse), LNTV (combined treatment with MPLA and 1×10<sup>6</sup> LNT cells) or SLCV (combined treatment with MPLA and 1×10<sup>6</sup> SLCs) (n=6). The treatment process is the same as Fig. 5A. **(H)** Tumor volumes were recorded every two days until day 19 (n = 6). **(I)** Kaplan–Meier survival curves of the mice of different treatment groups (n=6). **(J)** Representative flow cytometry data for frequency and quantification of tumor infiltrating CD8<sup>+</sup> T cells (n=6). Data represent analyses of the indicated n mice per group, means ± S.D, and were analyzed by one-way two-sided ANOVA with GraphPad Prism software. \*P < 0.05; \*\*P < 0.01; \*\*\*P < 0.001; \*\*\*\*P < 0.0001.





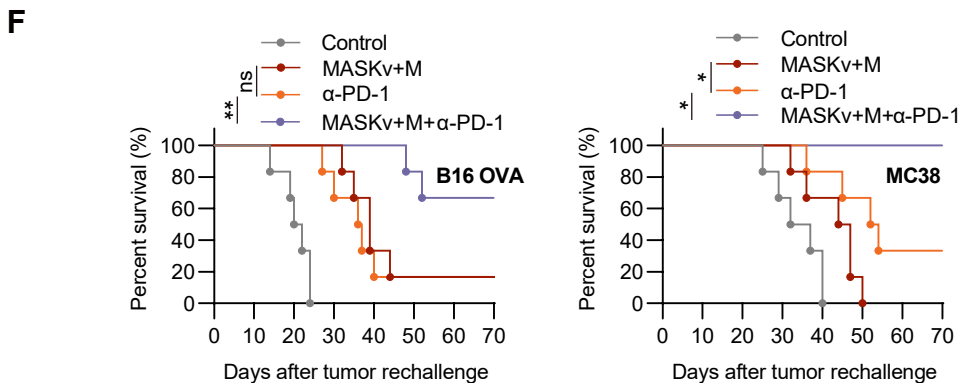
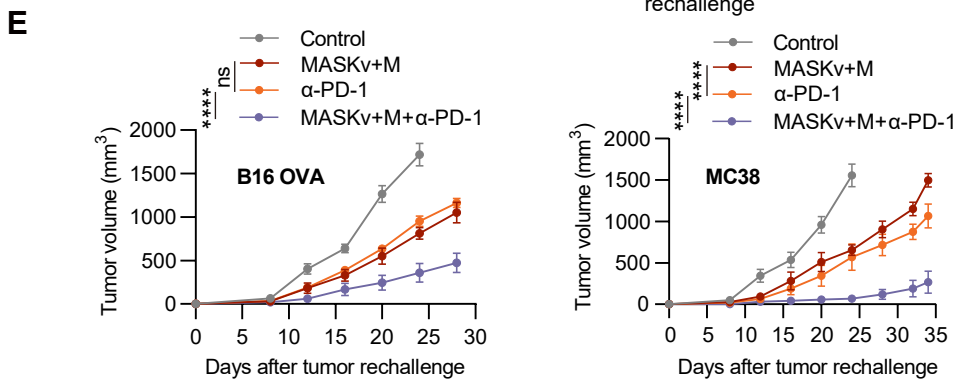
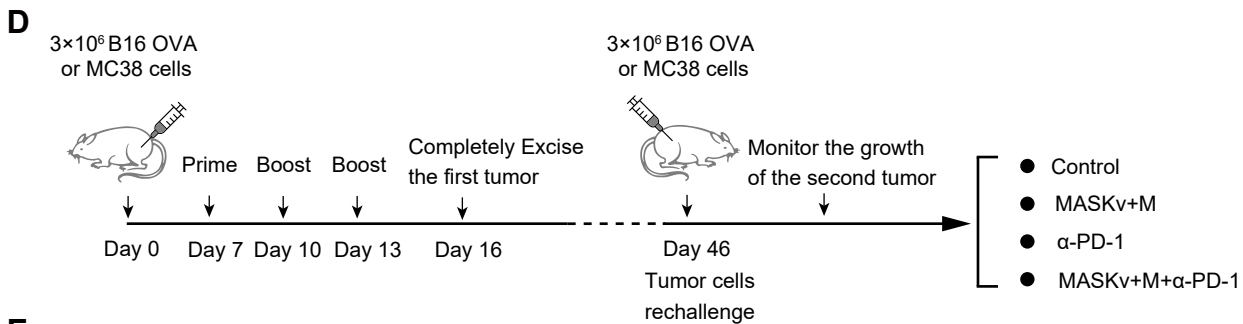
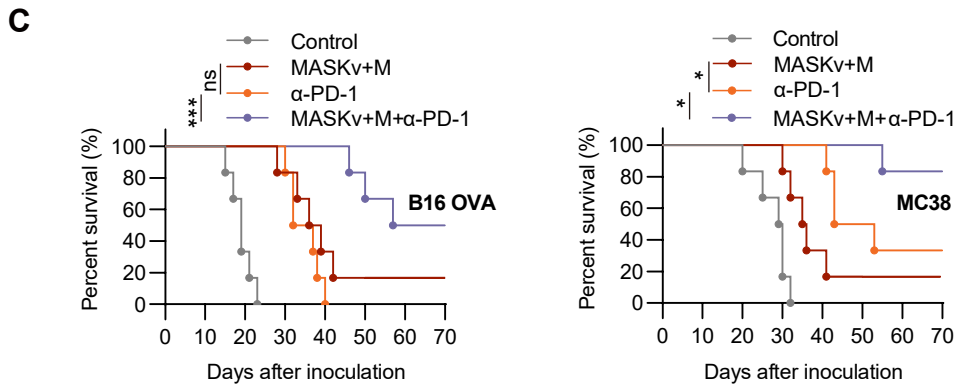
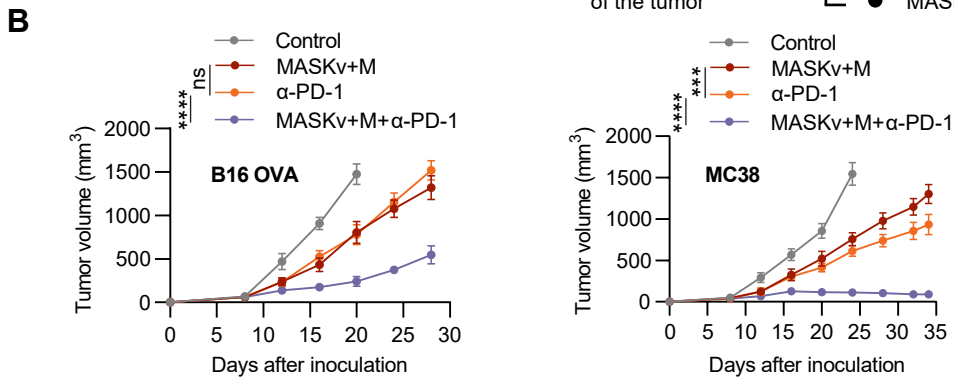
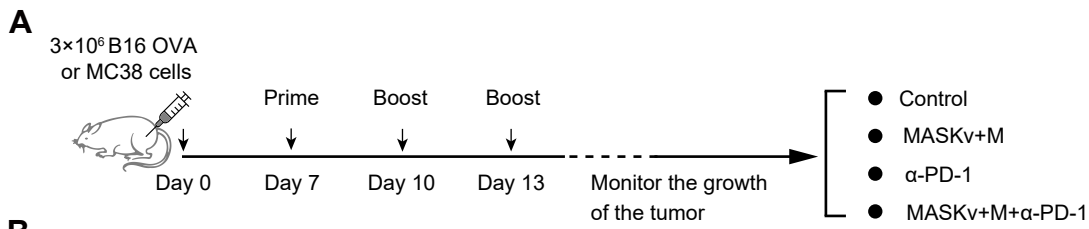
**Figure S5. Magnetic Characteristics of SLCs, related to Figure 5.**

(A) DNA, RNA and Protein were extracted from B16F10 living cells or SLCs respectively, and the quantitative statistical diagram of each component was obtained after magnetic attraction for 10 minutes ( $n=6$ ), magnet force = 0.2 T. Data represent analyses of the indicated  $n$  mice per group, means  $\pm$  S.D, and were analyzed by two-tailed unpaired  $t$  tests with GraphPad Prism software. ns, not significant,  $P > 0.05$ ; \*\*\*\* $P < 0.0001$ . (B) IVIS images of the whole body of mice, H22 liver tumor (green) and MASK (red) signal after intravenous injection of DiR-labeled MASKv. (C) Images and fluorescence intensities of the blood collected from the mice at indicated time points after intravenous injection of DiR-labeled MASKv.



**Figure S6. Analysis of SLCV impact on various immune cells using spatial transcriptomics sequencing, related to Figure 6.**

Using spatial transcriptomics sequencing data, the mMCP-counter package was employed to calculate the immune cell scores at different time points (Day 7, Day 13) after SLCV treatment. Immune cells marked in red indicate an increased score and activation following SLCV treatment; immune cells marked in blue indicate an increased score and inhibition; and immune cells marked in gray show no significant fluctuation in scores after SLCV treatment.



**Figure S7. Assessment of combined antitumor efficacy of MASKv and anti-PD-1 antibodies in mice with subcutaneous B16 OVA and MC38 tumors, related to Figure 7.**

**(A)** Schematic of B16 OVA or MC38 tumor model construction and in vivo treatment. **(B)** Tumor volumes were recorded at different time points (n = 6). **(C)** Kaplan–Meier survival curves of the mice of different treatment groups (n=6). **(D)** Schematic representation of B16 OVA or MC38 tumor rechallenge. **(E)** Tumor volumes were recorded at different time points after tumor rechallenge (n = 6). **(F)** Kaplan–Meier survival curves of the mice of different groups (n=6). Data represent analyses of the indicated n mice per group, means  $\pm$  S.D, and were analyzed by one-way two-sided ANOVA with GraphPad Prism software. ns, not significant,  $P > 0.05$ ; \* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ ; \*\*\*\* $P < 0.0001$ .