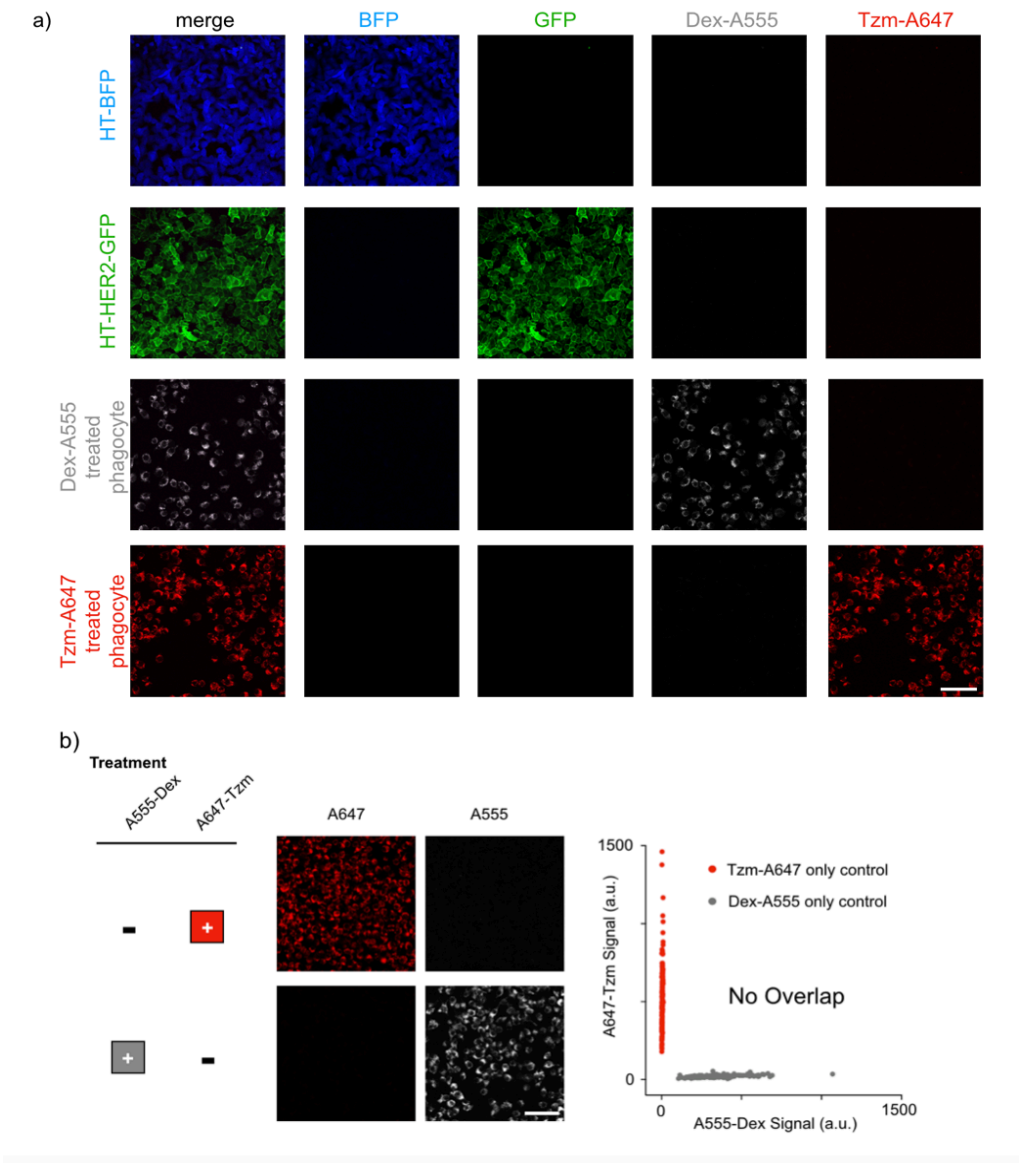
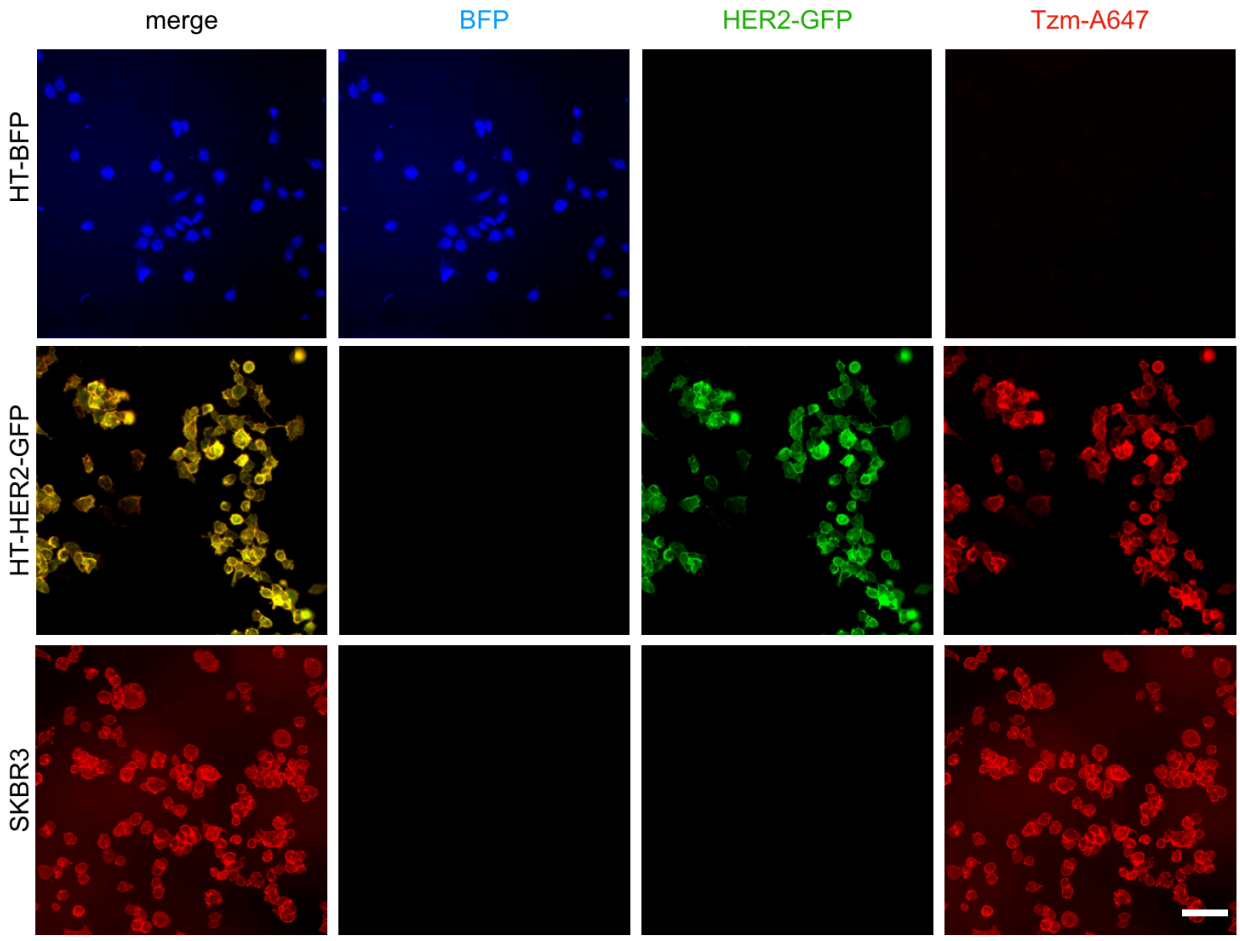
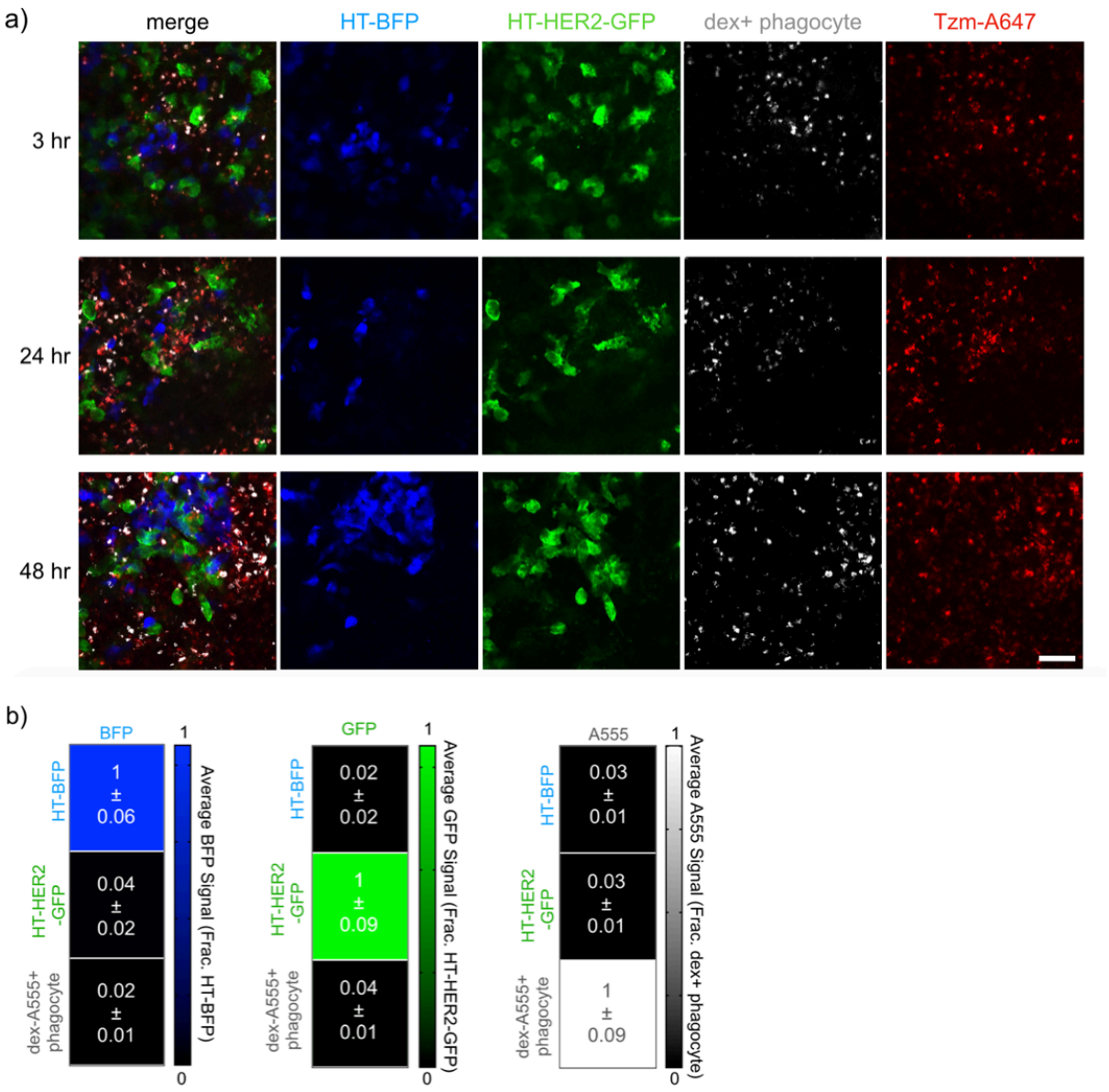


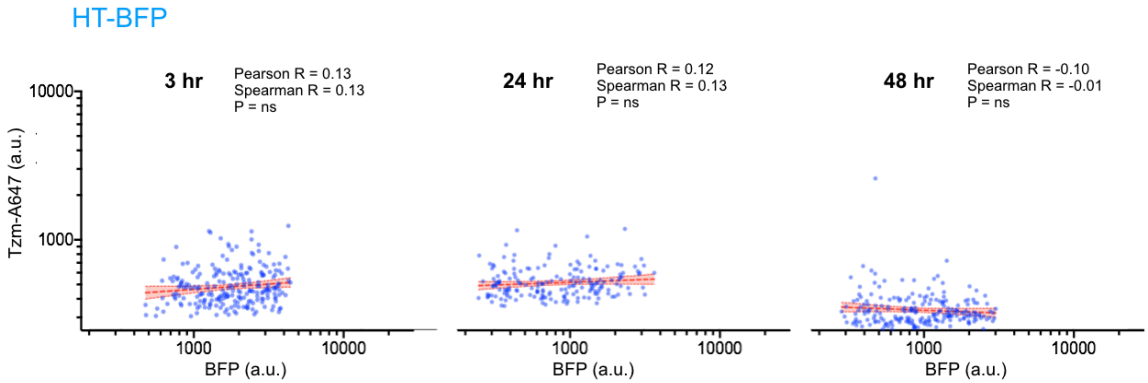
Supplementary Fig. 1. No fluorescent bleed-through was observed with fluorophore used. HT-BFP cells, HT-HER2-GFP cells, Dex-A555 treated Raw phagocytes, or Tzm-A647 treated Raw phagocytes were imaged for single-fluorophore control experiments. (**a**) Representative fluorescent images of single-fluorophore control showing no fluorescent bleed through with microscopy setting employed. (**b**) Quantification of fluorescent intensities in A555 and A647 channels in Tzm-A647 and Dex-A555 control samples showing no signal overlap between these two adjacent imaging channels. Scale Bars=50 μm.



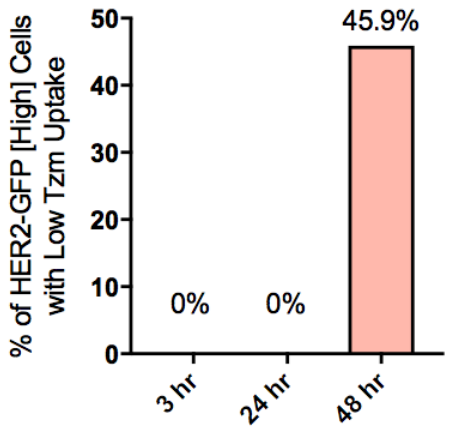
Supplementary Fig. 2. Tzm-A647 binds selectively to cells expressing HER2.
Representative fluorescent microscopy showing selective Tzm accumulation on HT1080 cells over-expressing HER2-GFP fusion protein (HT-HER2-GFP, middle) and SKBR3 (bottom) but not HER2-negative HT-BFP cells. Scale bar=50 μm.



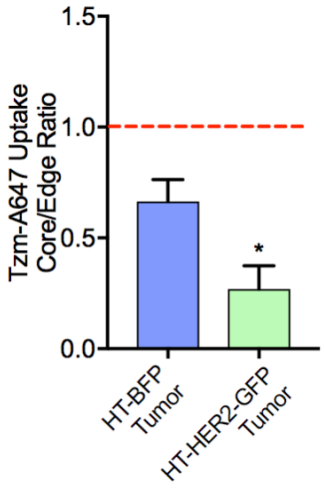
Supplementary Fig. 3. Tzm-A647 predominantly accumulates in phagocytes and HER2+ tumor cells. a) Representative *in vivo* images (3 h, 24 h, and 48 h) of Tzm-A647 biodistribution in mosaic tumors at single-cell resolution (Scale bar=50 μm). b) Quantification of fluorescent intensity in BFP, GFP, and A555 channels for HT-BFP, HT-HER2-GFP, and dex-A555^{+} phagocytes (data are mean ± s.e.m form n>50 cells).



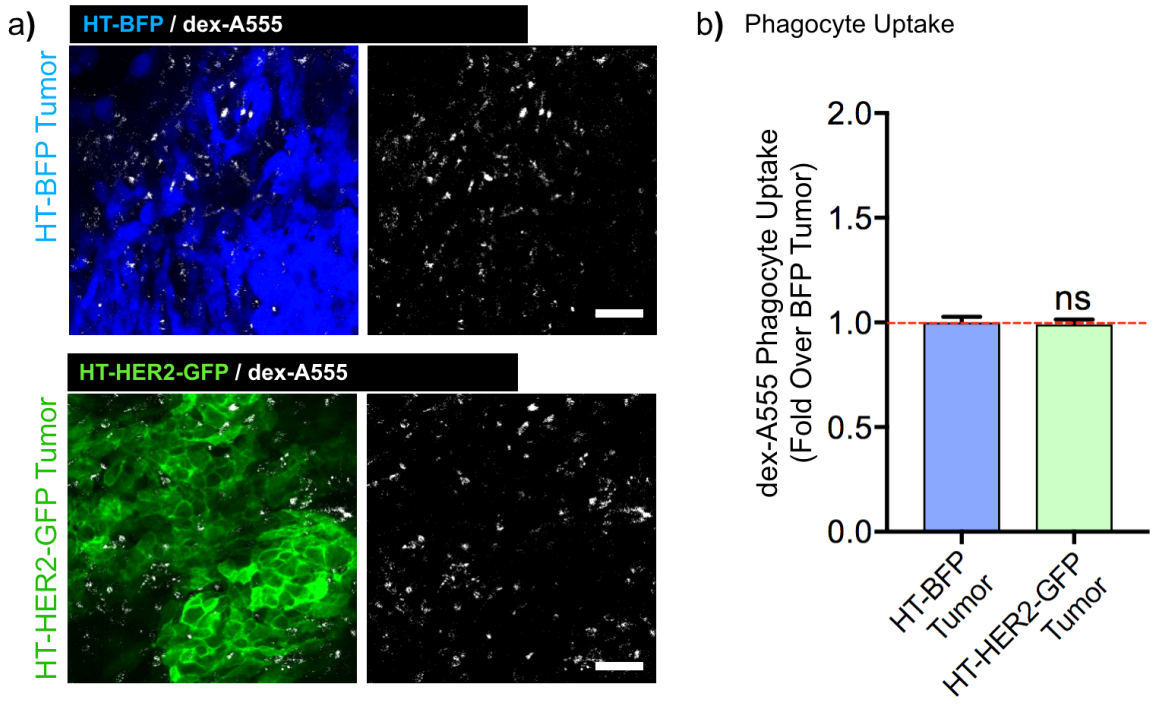
Supplementary Fig.4. BFP expression does not correlate with Tzm association in the mosaic tumor. BFP fluorescence intensity was plotted against Tzm uptake across individual HT-BFP cells in the mosaic tumor model (Spearman and Pearson correlation R and P values reported, n > 180 cells).



Supplementary Fig.5. Cells with high HER2-GFP expression but low Tzm binding are only observed at 48 h post-treatment with Tzm. The percent of cells with high HER2-GFP expression (defined as top 20% of expression) that are low in Tzm uptake (defined as bottom 20% of Tzm signals) was calculated across n = 15-50 cells at 3 time-points.



Supplementary Fig.6. Tzm-A647 accumulates at the tumor edge of both HER2+ and HER2- tumors. Quantification of the ratio of Tzm-A647 intensity at the core to the intensity at the edge of the tumor from Fig. 6C (mean ± s.e.m from 6 tumors, *: $p<0.05$, t-test).



Supplementary Fig.7. HER2 expression on tumor cells does not impact uptake of dextran-A555 by neighboring phagocytes. **(a-b)** The uptake of dextran-A555 in tumor-associated phagocytes was compared between uniformly HER2+ and HER2- tumors, corresponding to the experimental scheme in Fig. 6a, and is shown as representative confocal microscopy (**a**; scale bars=50 μm) and matched quantification (**b**; mean ± s.e.m. from n=100 cells across two conditions, ns = not significant, t-test).

HT-BFP	3 hr vs 24 hr	ns
	3 hr vs 48 hr	ns
	24 hr vs 48 hr	ns
HT-HER2-GFP	3 hr vs 24 hr	ns
	3 hr vs 48 hr	ns
	24 hr vs 48 hr	ns
Phagocyte	3 hr vs 24 hr	ns
	3 hr vs 48 hr	ns
	24 hr vs 48 hr	ns

3 hr	HT-BFP vs. HT-HER2-GFP	**
	HT-BFP vs. Phagocyte	***
	HT-HER2-GFP vs. Phagocyte	ns
24 hr	HT-BFP vs. HT-HER2-GFP	**
	HT-BFP vs. Phagocyte	****
	HT-HER2-GFP vs. Phagocyte	ns
48 hr	HT-BFP vs. HT-HER2-GFP	ns
	HT-BFP vs. Phagocyte	***
	HT-HER2-GFP vs. Phagocyte	**

Supplementary Table 1: Results of statistical tests for values reported in Fig. 5 e and f.
ANOVA test with Tukey post-hoc test was used, ns:not significant, **: $p<0.01$, ***: $p<0.001$, ****: $p<0.0001$.