Electronic Supplementary Material (ESI) for Nanoscale Advances.

Supporting Information

Real-Time Surface-Enhanced Raman Scattering-Based Live Cell Monitoring for the Changes of Mitochondrial Membrane Potential

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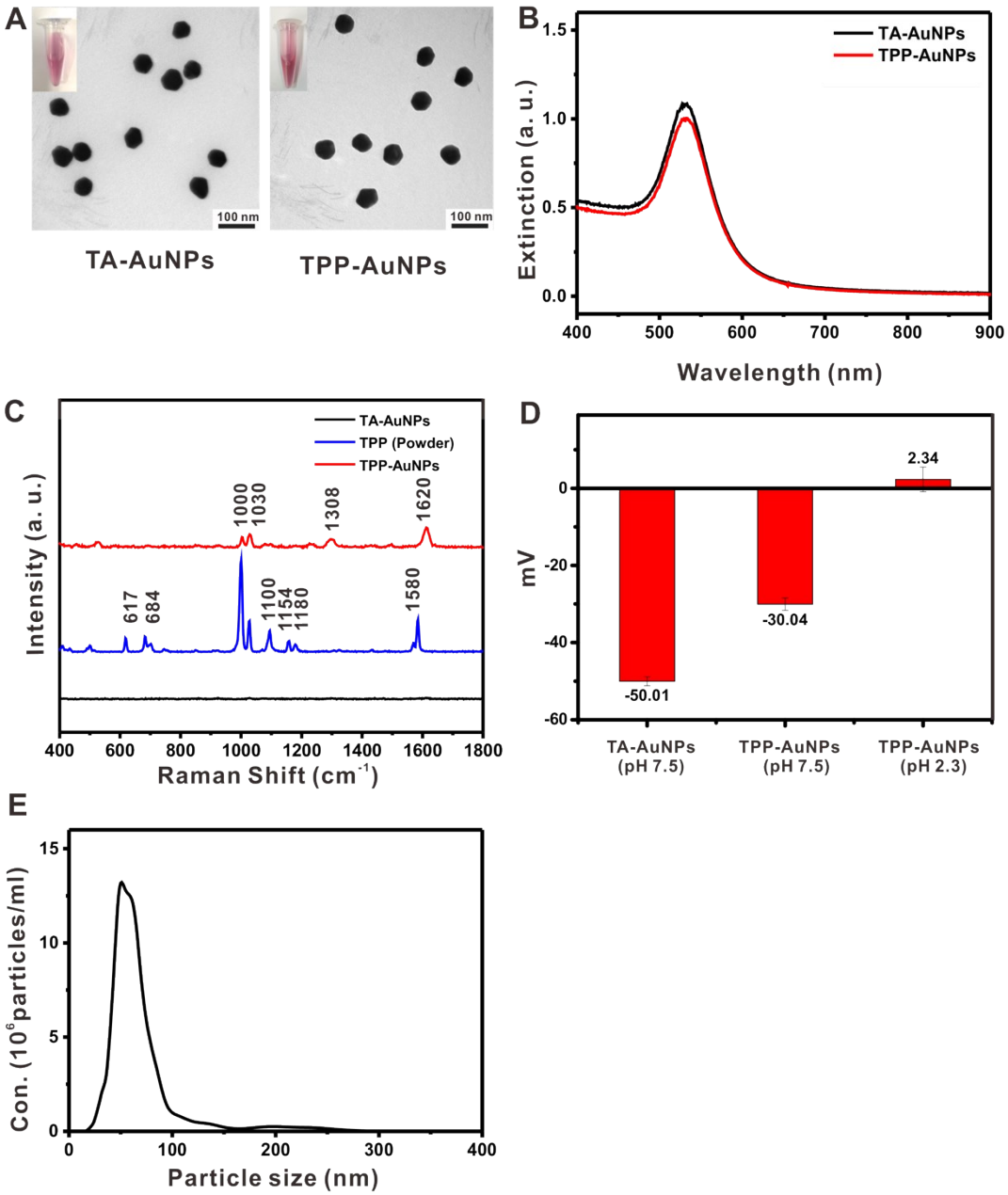

Figure S1. (A) TEM images [TA-AuNP, TPP-AuNP solution (inset)], (B) UV-visible spectrum, (C) Raman spectra, and (D) zeta potential analysis of TA-AuNPs and TPP-AuNPs, (E) hydrodynamic radius of TPP-AuNPs.

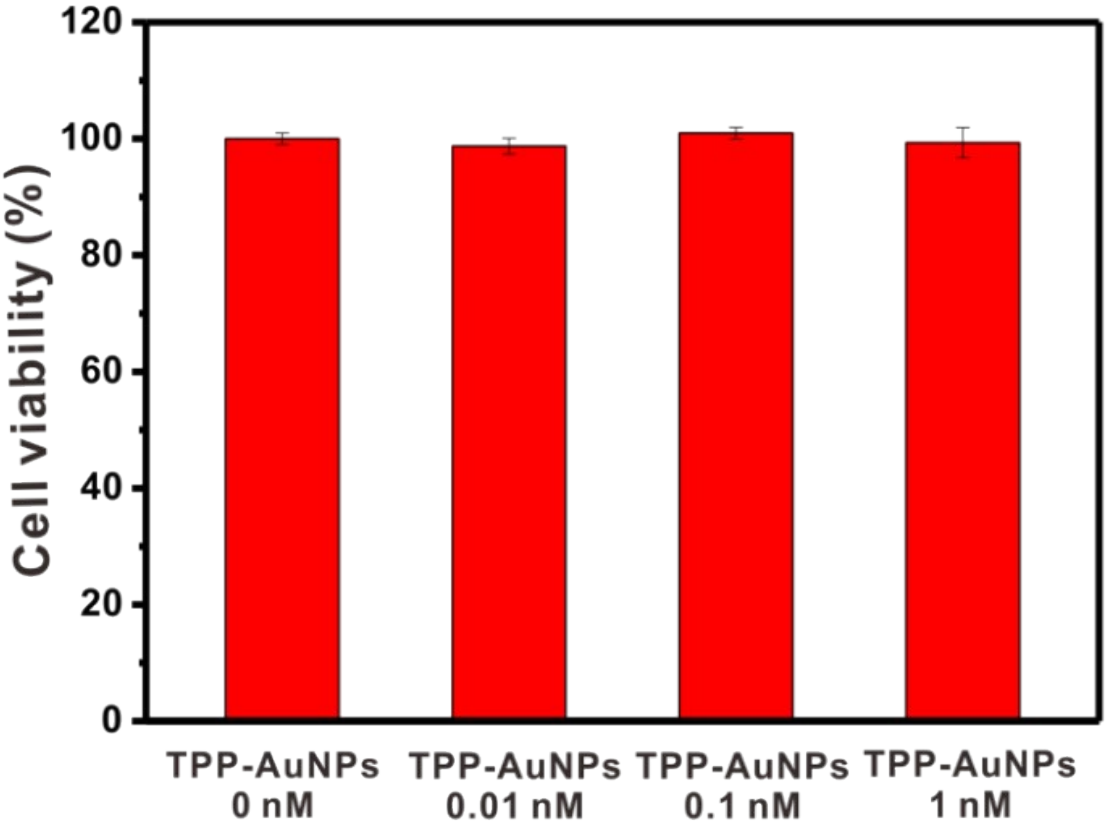

Figure S2. Cell viability results of control (0 nM) and TPP-AuNPs in RASFs at different concentrations (0.01 nM, 0.1 nM, and 1.0 nM) for 3 h (N = 4).

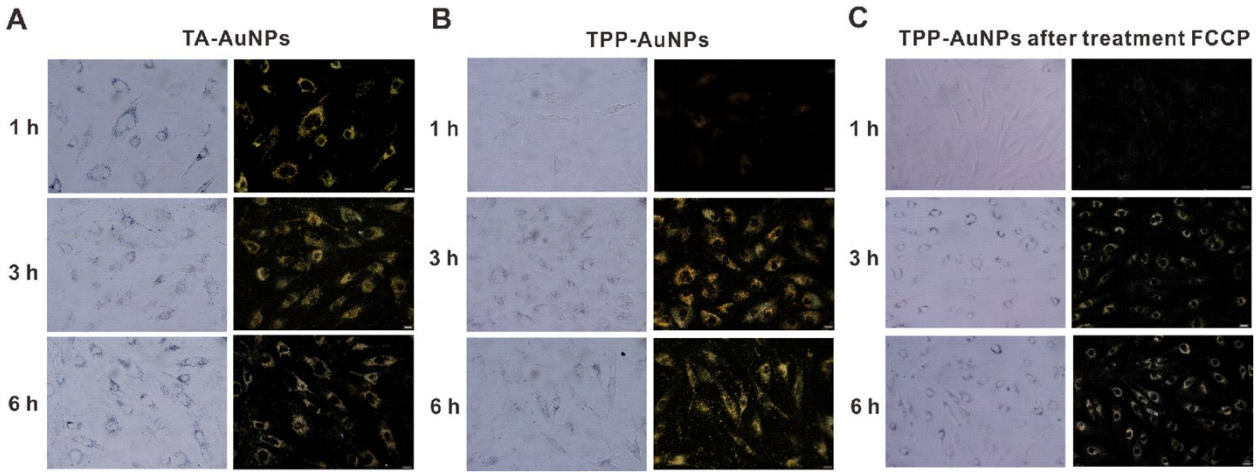

Figure S3. (A) Intracellular distribution of TA-AuNPs in RASFs observed by bright-field and dark-field microscopy after 1 h, 3 h, and 6 h. (B) Intracellular distribution of TPP-AuNPs in RASFs observed by bright-field and dark-field microscopy after 1 h, 3 h, and 6 h. (The initial concentration in cell culture media was 0.1 nM). (C) Intracellular distribution of TPP-AuNPs in RASFs 1 h, 3 h, and 6 h after treatment with FCCP (20 μM, 10 min) using bright-field and dark-field microscopy. (The initial concentration in cell culture media was 0.1 nM). Scale bar = 50 μm.

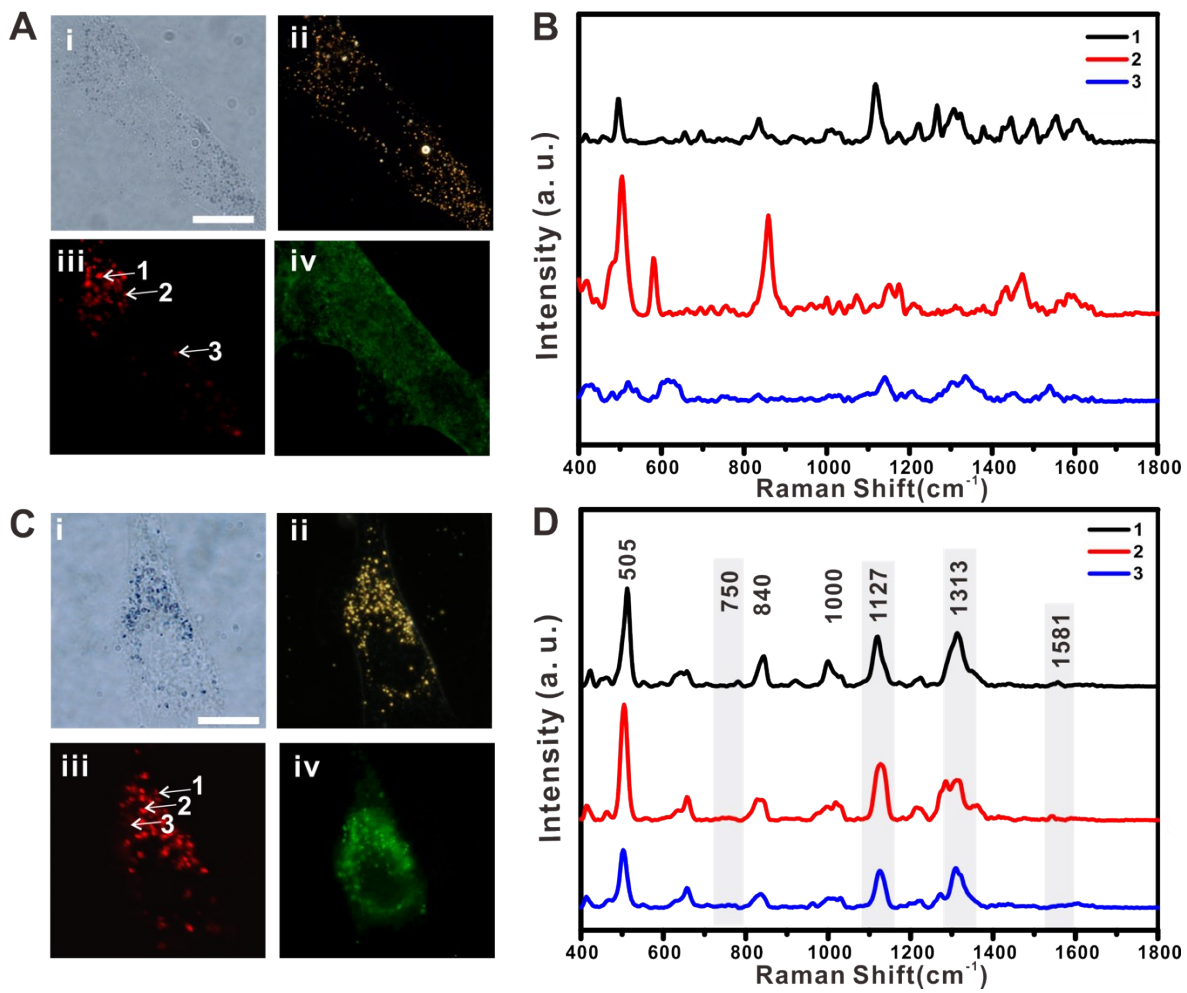

Figure S4. (A) Intracellular distribution of TA-AuNPs in rheumatoid arthritis synovial fibroblasts (RASFs) observed with bright field microscopy (i), dark field microscopy (ii), Raman mapping (iii), and fluorescence images (iv) stained with mito-tracker. (B) Raman spectra obtained from inside cells (A-iii, points 1, 2, and 3). (C) Intracellular distribution of TPP-AuNPs in rheumatoid arthritis synovial fibroblasts observed with bright field microscopy (i), dark field microscopy (ii), Raman mapping (iii) and fluorescence images (iv) stained with mito-tracker. (D) Raman spectra obtained from inside cells (C-iii, points 1, 2, and 3). Raman signals at 750, 1127, 1313, and 1581 cm^{-1} are assigned to the vibration mode of cytochrome c. (Scale bars = 20 μm).

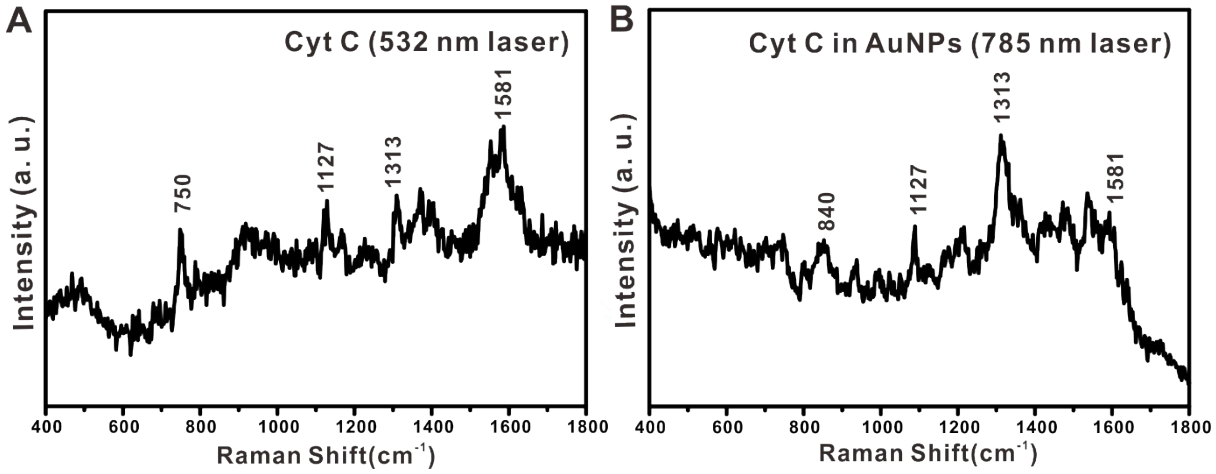

Figure S5. (A) Raman spectra of Cyt C obtained with 532 nm laser excitation, (B) Raman spectra of Cyt C obtained with 785 nm laser excitation.

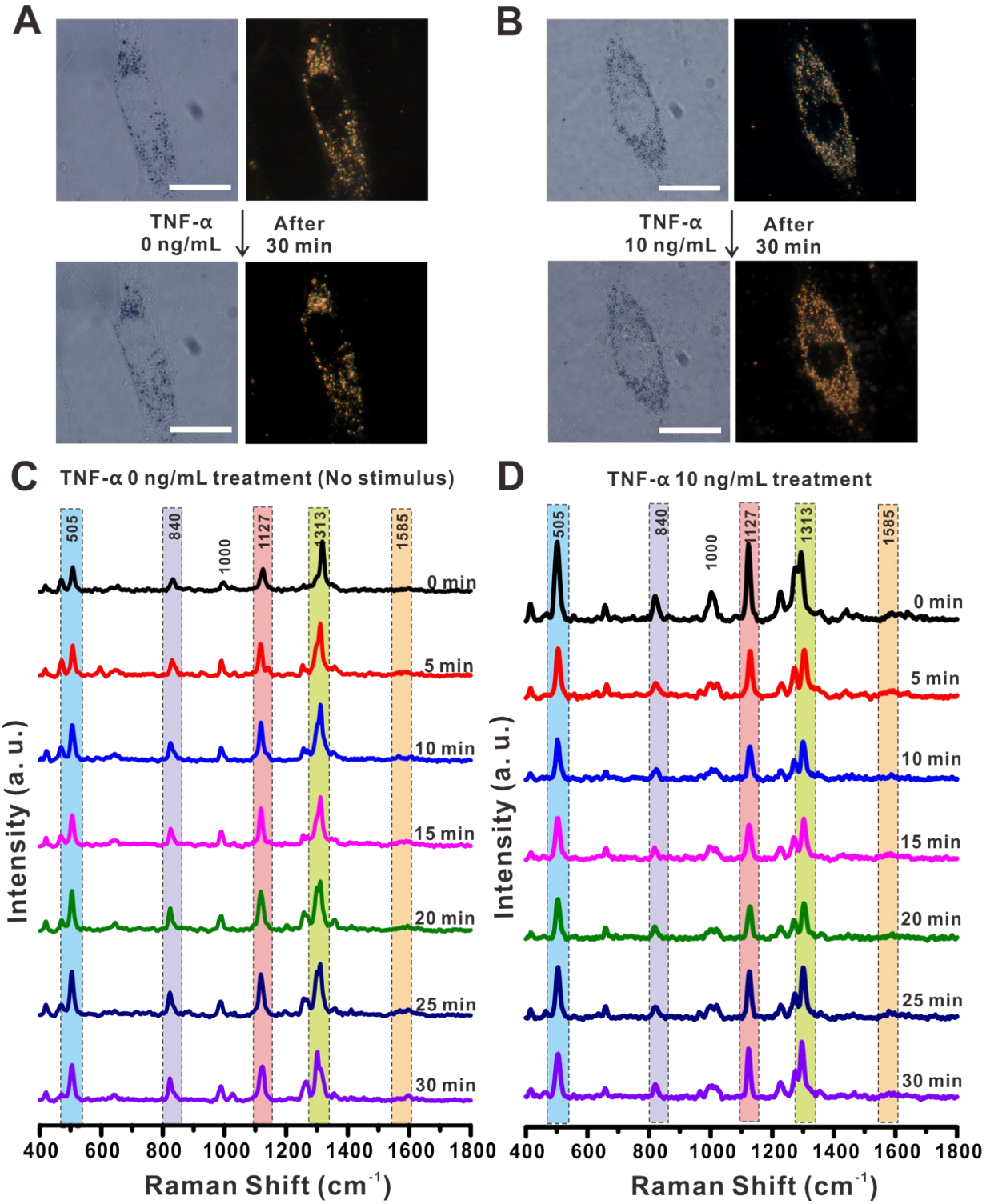

Figure S6. Bright-field and dark-field images before (A) and (B) after addition of 10 ng/mL TNF-α in RASFs. Time-dependent changes in Raman spectra from a single cell with (C) no stimulus and after addition of (D) 10 ng/mL TNF-α Scale bar = 20 μm.

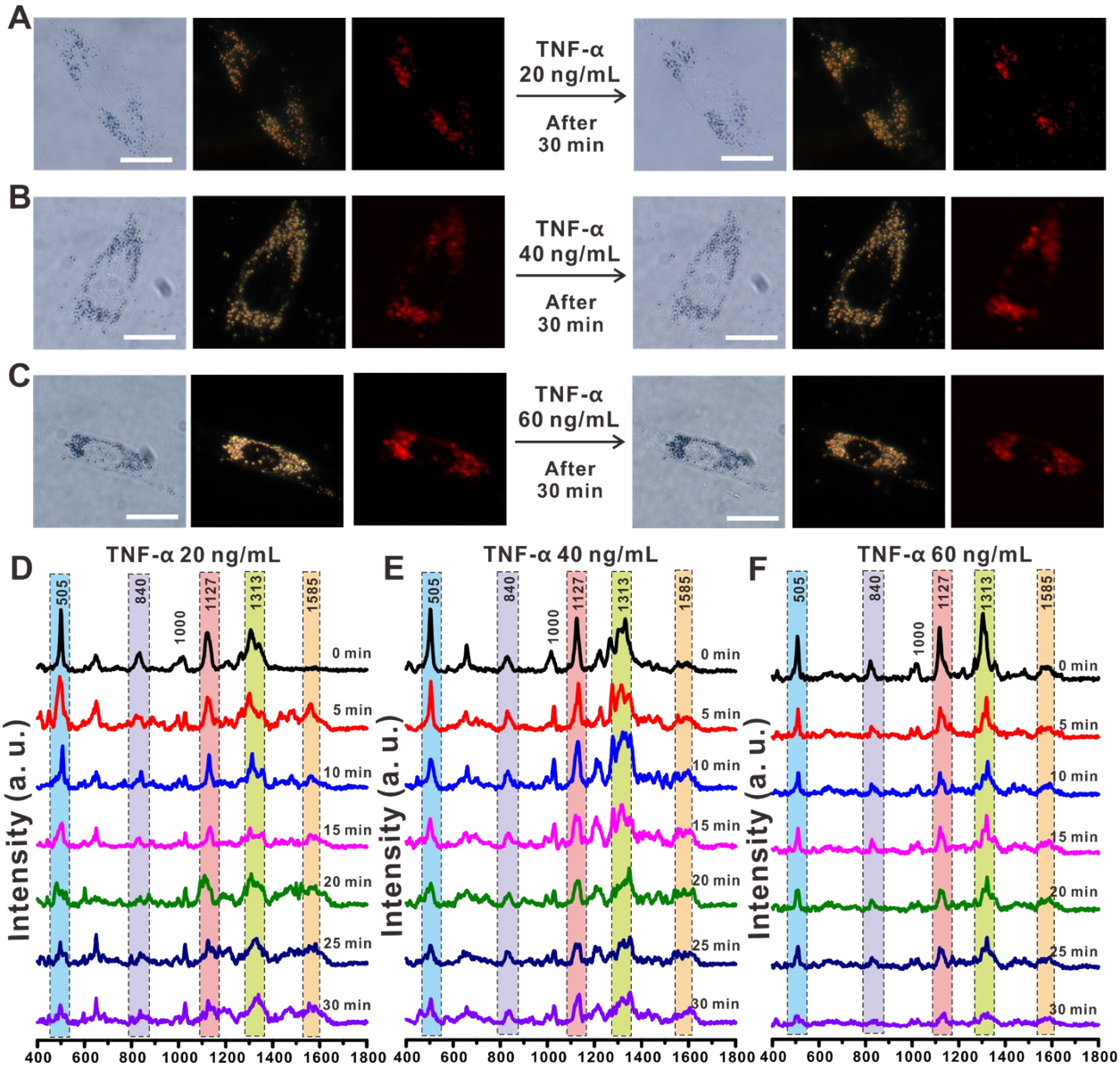

Figure S7. Bright-field, dark-field, and Raman images before and after addition of (A) 20 ng/mL, (B) 40 ng/mL, or (C) 60 ng/mL TNF- α in RASFs. Time-dependent changes in Raman spectra from a single cell after the addition of (D) 20 ng/mL, (E) 40 ng/mL, or (F) 60 ng/mL TNF- α. Scale bar = 20 μm.

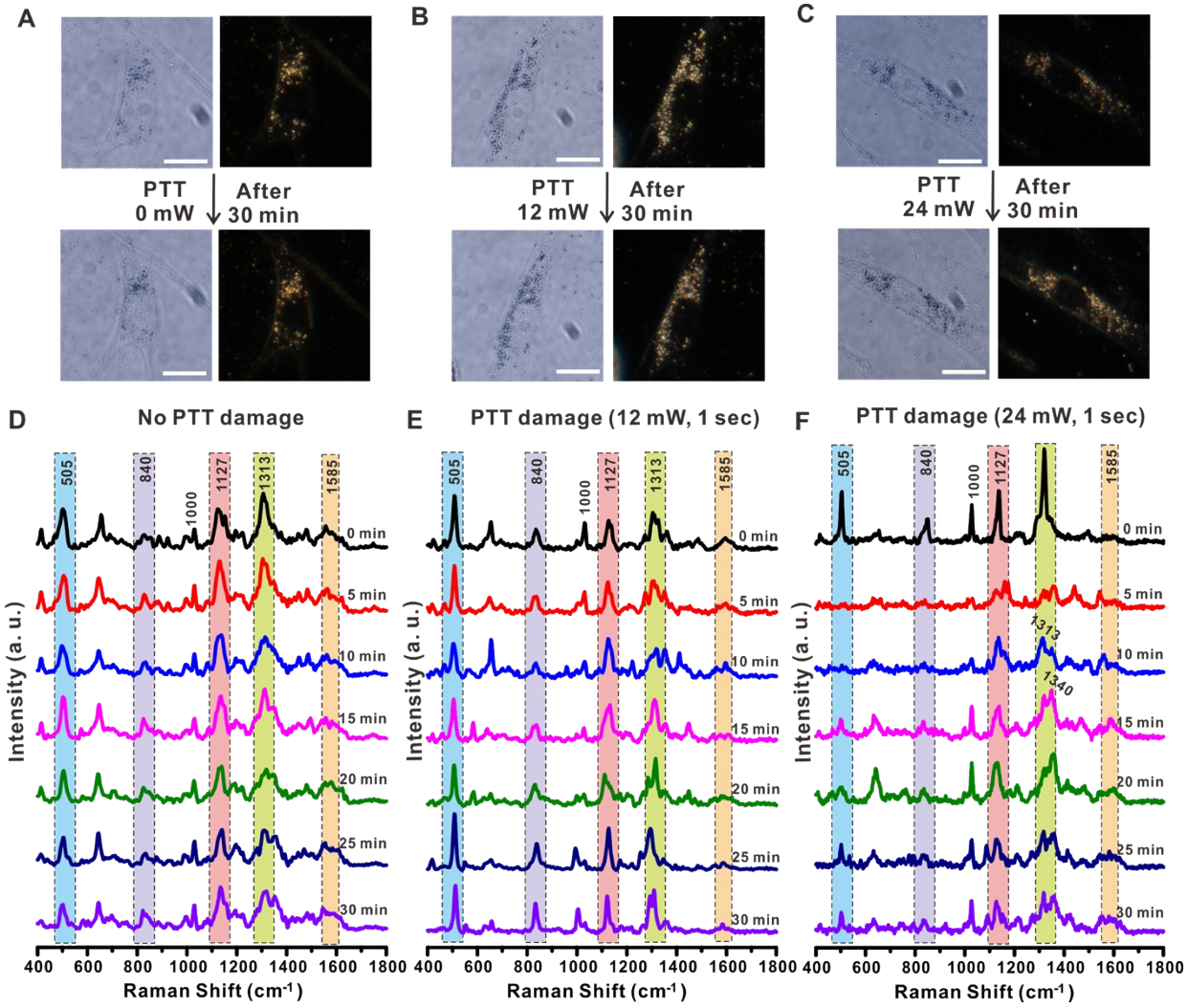

Figure S8. Bright-field and dark-field images before (A) and (B) after photothermal damage applied using a focused a laser of 12 mW (785 nm) or (C) 24 mW (785 nm) for 1 s. Scale bar = 20 μm. Time-dependent changes in Raman spectra from a single cell with (D) no photothermal damage, (E) with photothermal damage applied using a focused a laser of 12 mW (785 nm) for 1 s, or (F) with photothermal damage applied using a focused a laser of 24 mW (785 nm) for 1 s.

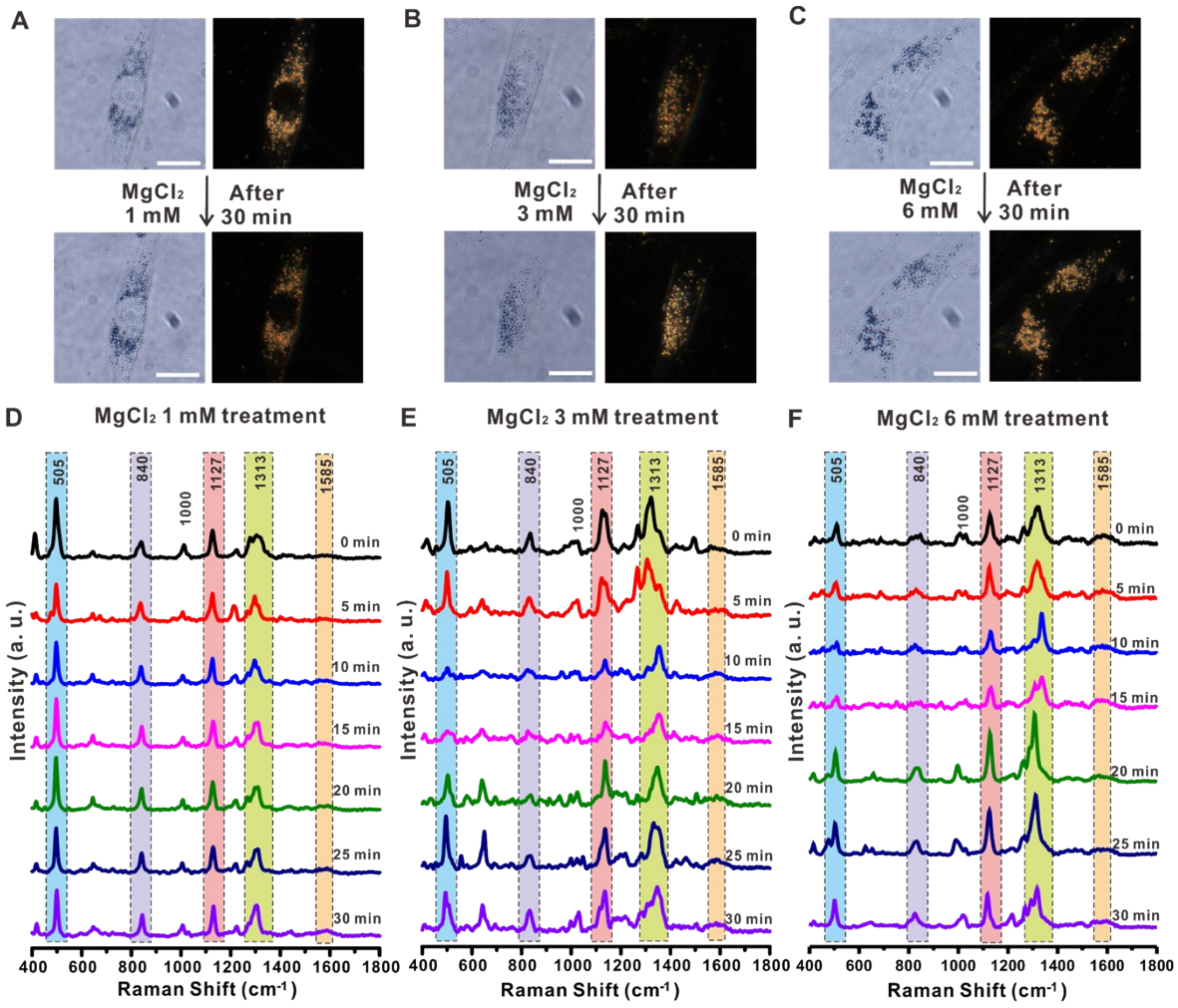

Figure S9. Bright-field and dark-field images before and after the addition of (A) $MgCl_2$ (1 mM), (B) 3 mM $MgCl_2$, or (C) 6 mM $MgCl_2$ in RASFs. Scale bar = 20 μm. Time-dependent changes in Raman spectra from a single cell after the addition of (D) 1 mM $MgCl_2$, (E) 3 mM $MgCl_2$, or (F) 6 mM $MgCl_2$.

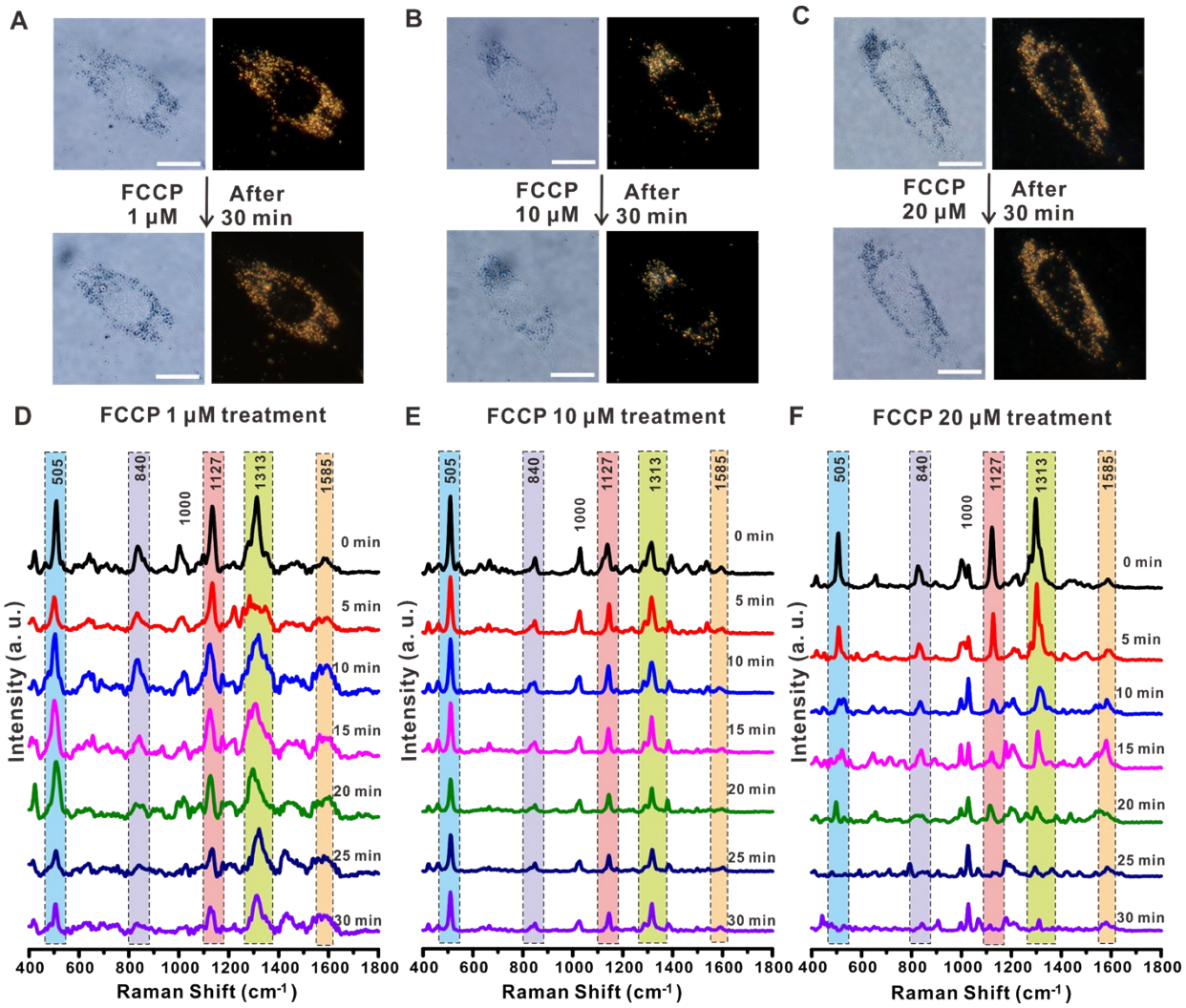

Figure S10. Bright-field and dark-field images before and after the addition of (A) 1 μM, (B) 10 μM, or (C) 20 μM FCCP in RASFs (scale bar = 20 μm). Time-dependent changes in Raman spectra from a single cell after the addition of (D) 1 μM, (E) 10 μM, or (F) 20 μM FCCP.

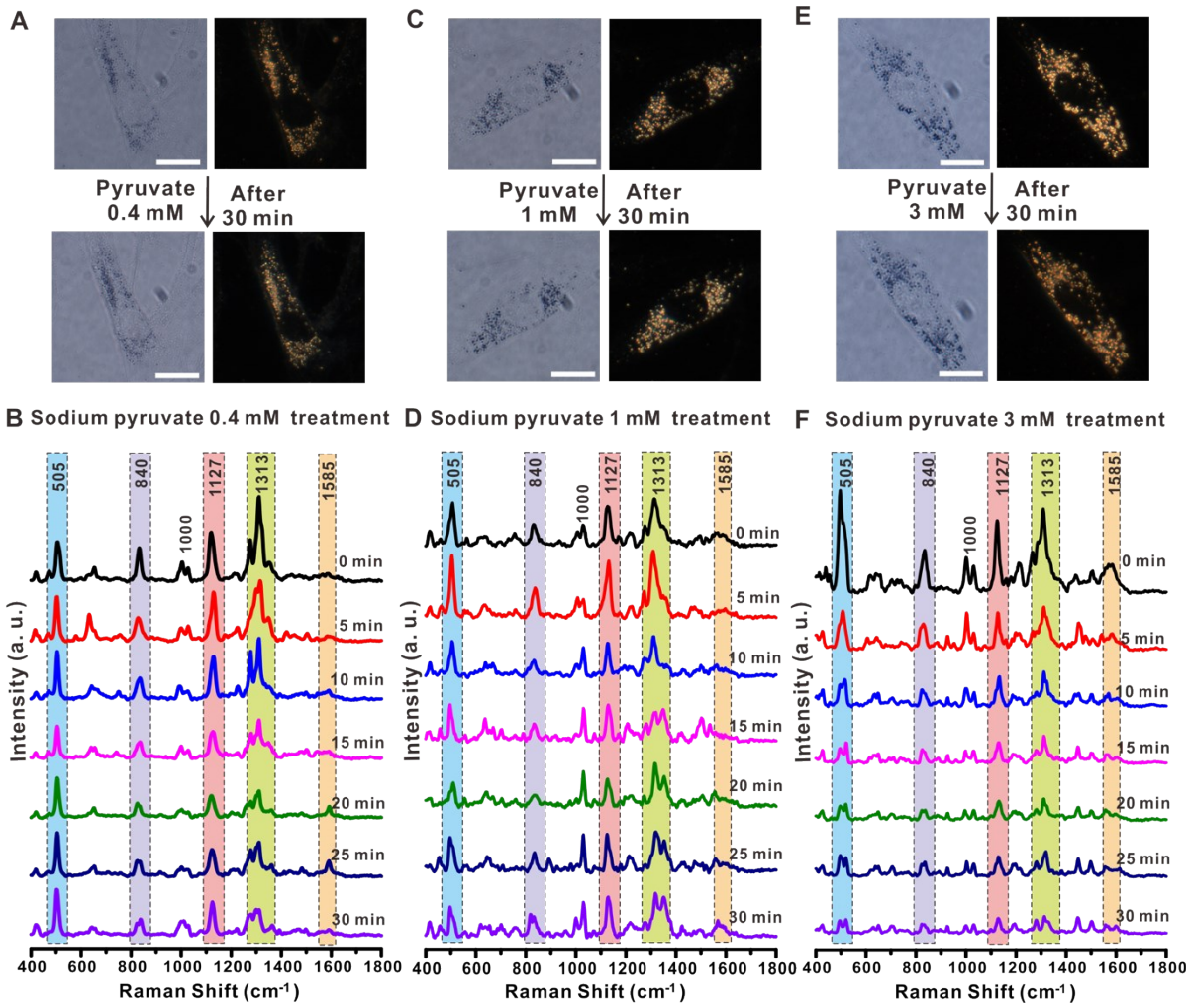

Figure S11. Bright-field and dark-field images before and after the addition of (A) 0.4 mM, (B) 1 mM, or (C) 3 mM sodium pyruvate in RASFs (scale bar = 20 μm). Time-dependent changes in Raman spectra from a single cell after the addition of (D) 0.4 mM, (E) 1 mM, or (F) 3 mM sodium pyruvate.