

Description of Additional Supplementary Files

Supplementary Movie 1. Patterning of 100 nm PS nanobeads on half-shield substrate ($\lambda = 80 \mu\text{m}$, (1/2)) and 110 nm PS beads ($\lambda = 120 \mu\text{m}$, (2/2)) with streaming using 1D AENT. Scale bars: $60 \mu\text{m}$.

Supplementary Movie 2. Patterning of 50 nm (1/2) and 28 nm (2/2) PS nanobeads using 1D AENT. Scale bars: $240 \mu\text{m}$.

Supplementary Movie 3. Abnormal patterns of fluorescent exosomes in isosmotic buffer (1/2) and 100 nm PS nanobeads in water (2/2) under high-amplitude excitation signals. Scale bars: $60 \mu\text{m}$.

Supplementary Movie 4. Transient displacement distribution of pulsed travelling acoustoelectronic waves forming time-of-flight (ToF) AENT.

Supplementary Movie 5. Harmonic merging and splitting of 100 nm PS beads using two frequency components ($\lambda_1 = 120 \mu\text{m}$, $\lambda_2 = 300 \mu\text{m}$). Scale bar: $60 \mu\text{m}$.

Supplementary Movie 6. Dynamic manipulation of CNTs. Continuously growing CNT pattern in flow with 1D AENT (1/3). Pattern transformation of CNTs using 2D AENT (2/3). Scale bars: $60 \mu\text{m}$. On-demand orientation control of CNTs with 2D AENT (3/3). Scale bar: $15 \mu\text{m}$.

Supplementary Movie 7. Single nano-particle manipulation. (1/2) Patterning 400 nm PS beads and (2/2) repeated pairing and release of single 400 nm particles using 2D AENT. Scale bars: $50 \mu\text{m}$.