Supplementary Information for Two-Photon Micro-Printed Ag_2Te QD–Polymer Hybrid Photonic Platform on Fibre End for Transformative 2D Thermo-Optic Modulation

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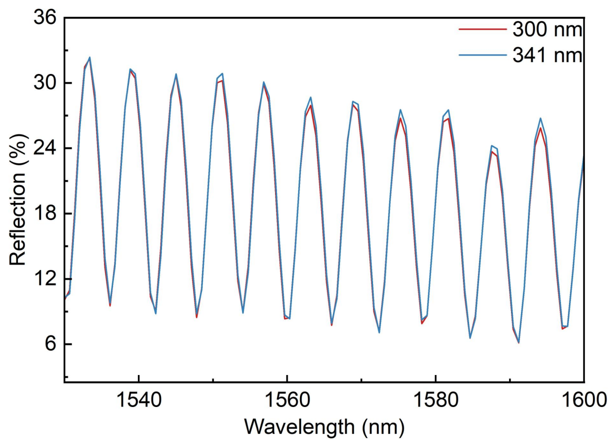


Fig. S1 FDTD simulated reflection spectra for gap sizes of 300 nm (red curve) and 341 nm (blue curve).

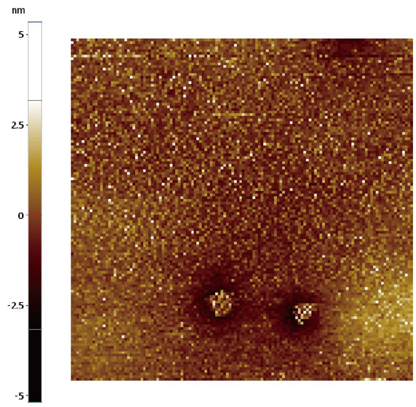


Fig. S2 AFM image of the Ag_2Te QD-coated surface, showing uniform distribution of QDs with a root-mean-square roughness of 0.652 nm.

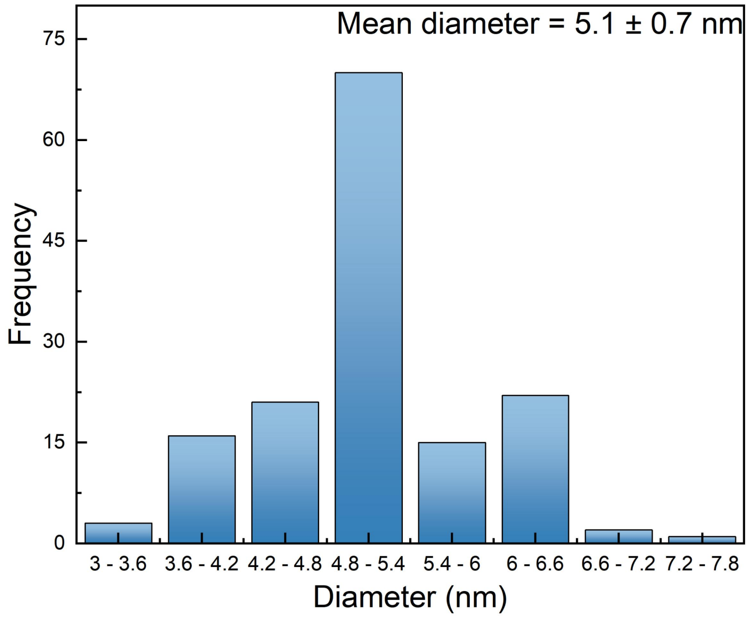


Fig. S3 Particle size distribution histogram of 150 randomly selected Ag_2Te QDs, showing an average diameter of 5.1 ± 0.7 nm.

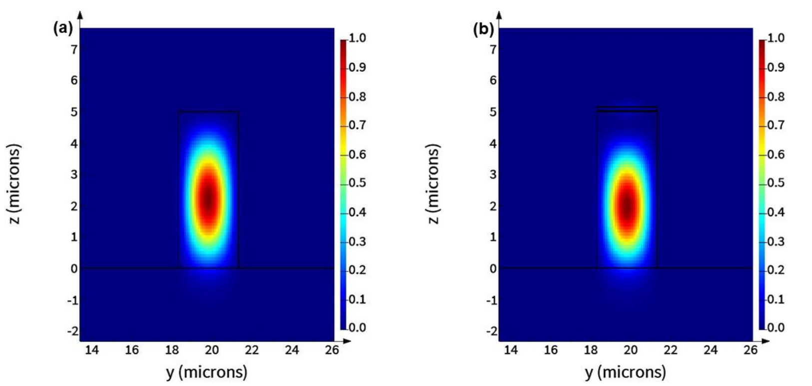


Fig. S4 **a** Simulated fundamental polarized mode profiles before and after Ag_2Te QD coating at 1558 nm. **b** Mode profile after QD coating.

Steady-state heat conduction

The temperature distribution induced by optical absorption satisfies the steady-state heat conduction equation

$$-k\nabla^2 T + Q_{\text{gen}} = 0, \qquad \text{(S5)}$$

where k is the thermal conductivity of the polymer waveguide and T is the temperature.

Under the steady-state approximation, the average temperature rise can be expressed as

$$\Delta T = \frac{Q_{\text{gen}} V}{h_{\text{eff}}}, \qquad \text{(S6)}$$

where Q_{gen} is the volumetric heat generation rate, V is the effective heated volume, and h_{eff} represents the equivalent heat dissipation coefficient accounting for heat loss to the surrounding environment.

Thermo-optic refractive index modulation

The temperature increase induces a refractive index change via the TO coefficient

$$\Delta n_{\text{eff}} = \Gamma \frac{dn_{\text{eff}}}{dT} \Delta T, \qquad \text{(S7)}$$

where Γ is the overlap factor between the optical mode and the thermally perturbed region of the waveguide.

Substituting Eqs. (S5) and (S6) into the resonance condition yields the wavelength shift expression presented as Eq. (7) in the main text.

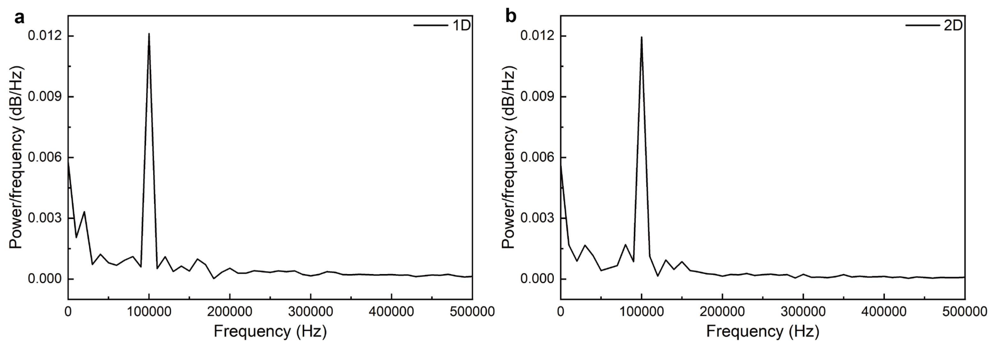


Fig. S8a Frequency response of the 1D modulation scheme. **S8b** Frequency response of the 2D modulation scheme

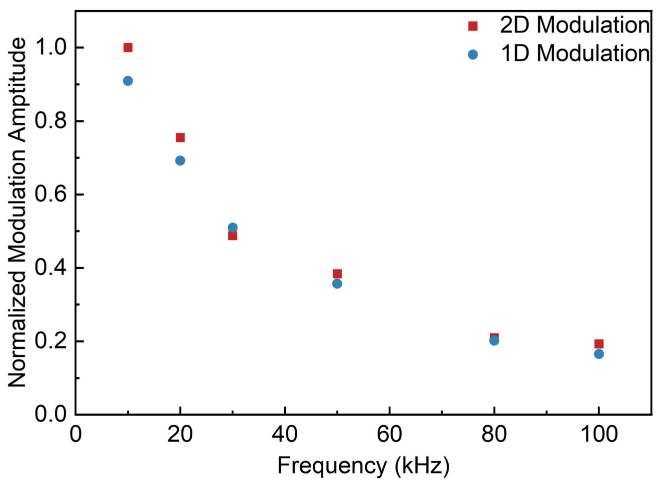
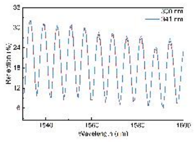
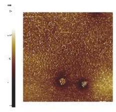
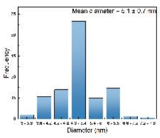


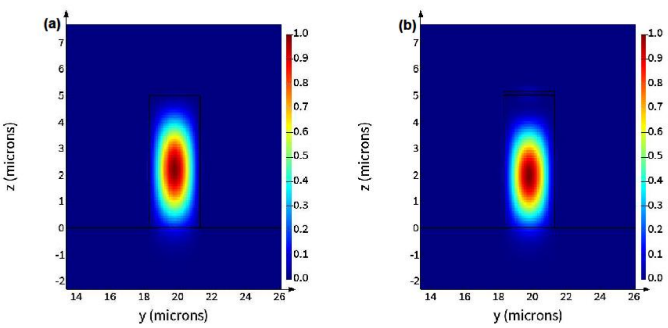
Fig. S9 Comparison of the normalized modulation amplitude versus frequency for both 1D and

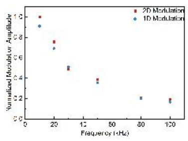
2D modulation schemes.



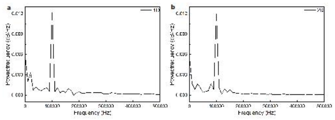





(a)
(b)
z (microns)
y (microns)
7
6
5
4
3
2
1
0
-1
-2
14
16
18
20
22
24
26
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0



2D Modulation
1D Modulation
Frequency (kHz)



a
b