Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B.

Supporting Information

Dual-functional carbon dots-silver@ zinc oxide nanocomposite: *In vitro* evaluation of cellular uptake and apoptosis induction

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Fluorescence quantum yield determination

Fluorescence quantum yield of samples in water was calculated according to the following equation using quinine sulphate as a standard (Q_R = 0.54 at 360 nm):

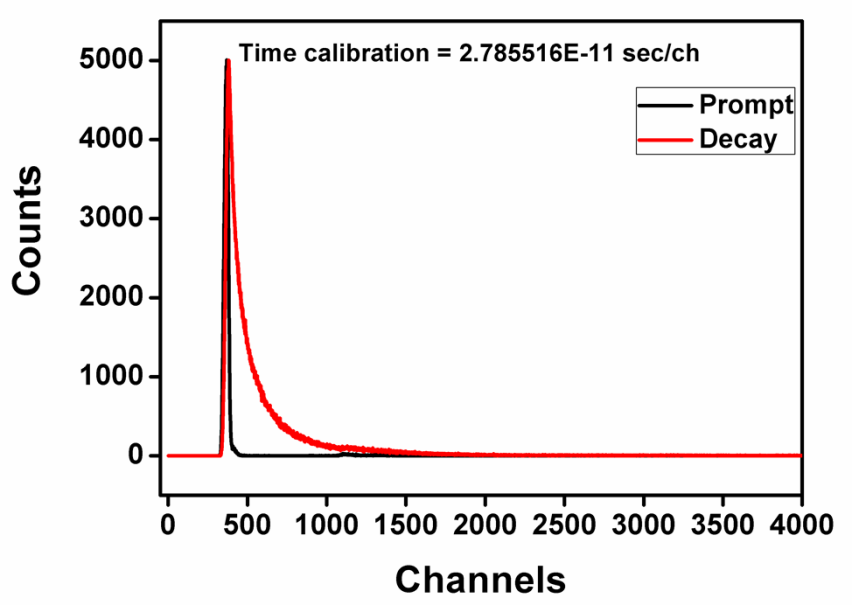
$$Q = Q_R \times \frac{I}{I_R} \times \frac{A_R}{A} \times \frac{\eta^2}{\eta^2_R}$$

Where Q represents the quantum yield of desired sample, I is the measured integrated emission intensity (area under the curve), refractive index being η and A stands for optical density. Subscript R signifies the reference fluorophore of known quantum yield. To eliminate the likelihood of re-absorption effects, the absorption in the 10 mm cuvette was always kept under 0.1 at the excitation wavelength. The emission range of the samples used for area calculation was kept between 375-700 nm.

Sample	**Integrated emission intensity *(I)***	**Absorbance at 360 nm *(A)***	**Refractive index of solvent (η)**	**Quantum yield at 360 nm *(Q)***
Quinine sulphate	658172	0.0728	1.33	0.54 (known)
CDs	92856	0.0823	1.33	0.0674
CD-Ag@ZnO	88239	0.0821	1.33	0.0642

Table S1. Quantum yield measurements.

A



B

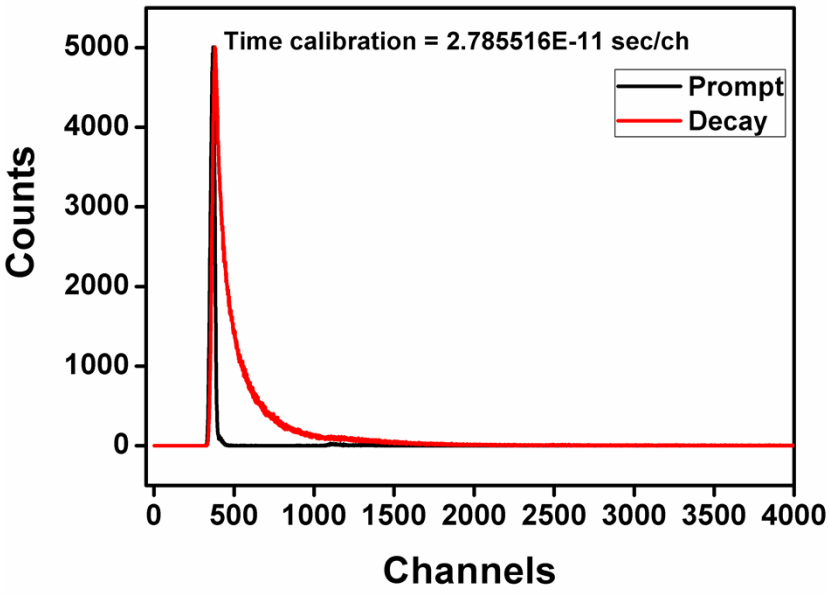


Fig. S1. Fluorescence decay curve of (A) CDs and (B) CD-Ag@ZnO (λ_{ex} = 320 nm; λ_{em} = 400 nm).

Sample	a_1	τ_1(ns)	a_2	τ_2(ns)	a_3	τ_3(ns)	τ_{av}(ns)	χ^2
CD	0.5409	3.306	0.1521	0.590	0.3070	10.833	5.204	1.169
CD-Ag@ZnO	0.5323	3.334	0.1634	0.644	0.3043	10.369	5.035	1.157

Table S2. Tabular representation of fluorescence lifetime calculation.

Average lifetime (τ_{av}) was calculated by using the following equation:

$$\tau_{av} = a_1\tau_1 + a_2\tau_2 + a_3\tau_3$$

where τ_1, τ_2 ,τ_3 were the first, second and third component of the decay time of CDs and a_1, a_2 ,a_3 were the corresponding relative weightings(emission %) of these components, respectively.

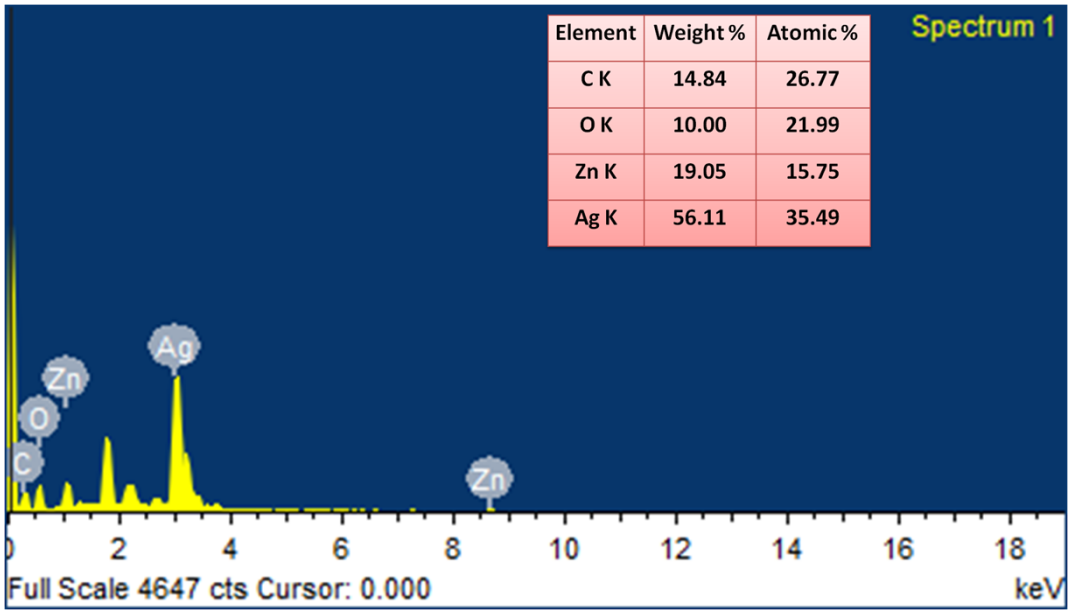


Fig. S2. EDAX spectrum and elemental composition of CD-Ag@ZnO NC.

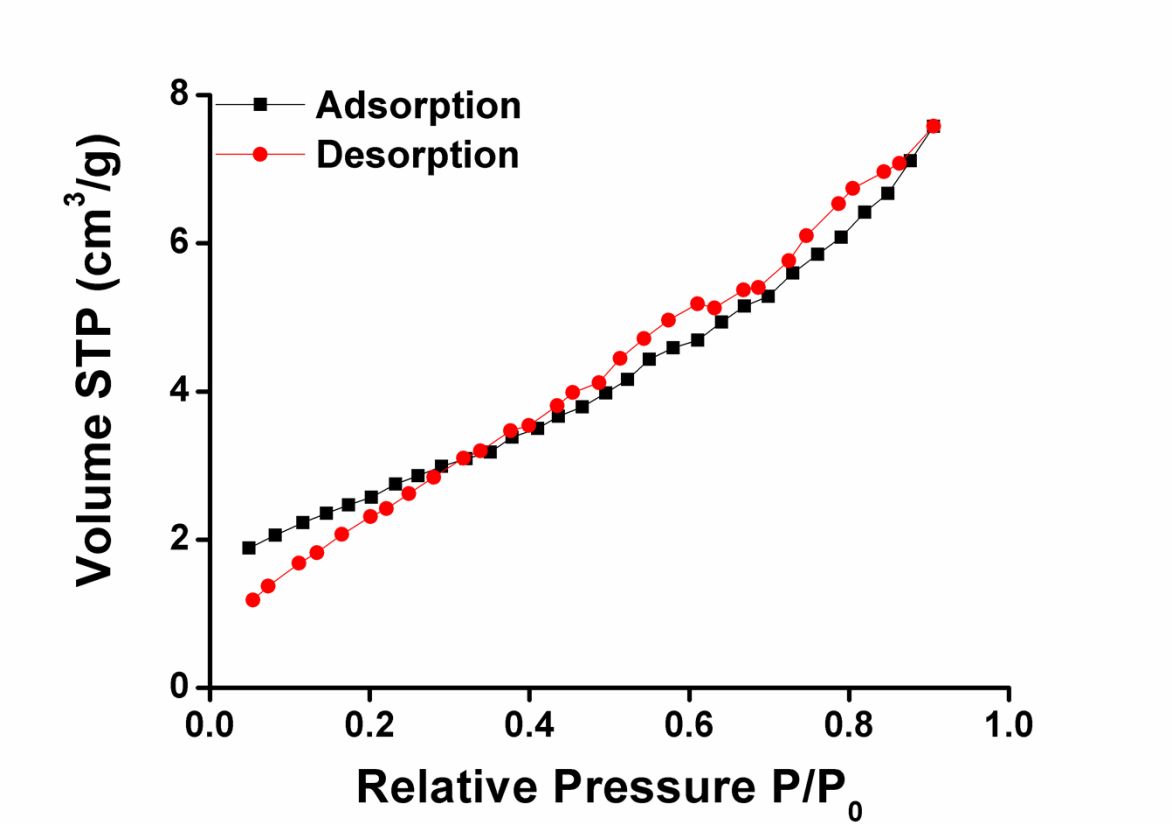


Fig. S3. N_2 adsorption–desorption isotherms for Ag@ZnO.

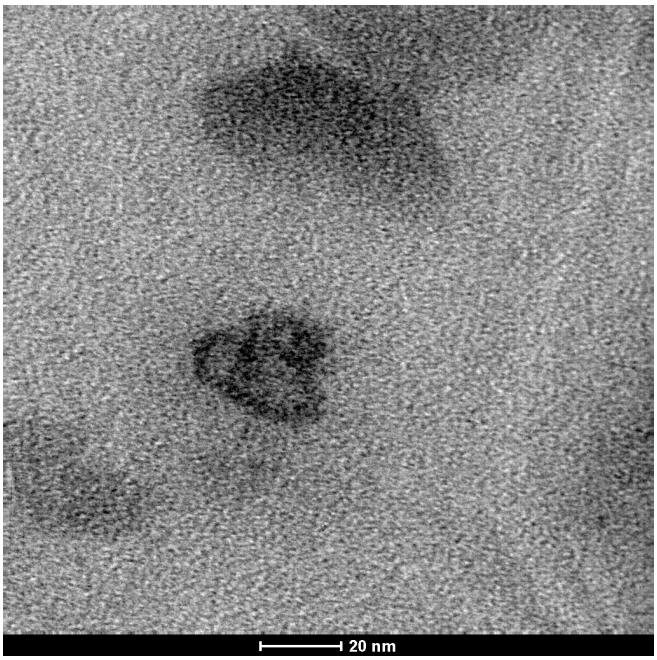


Fig. S4. TEM image of CDs.

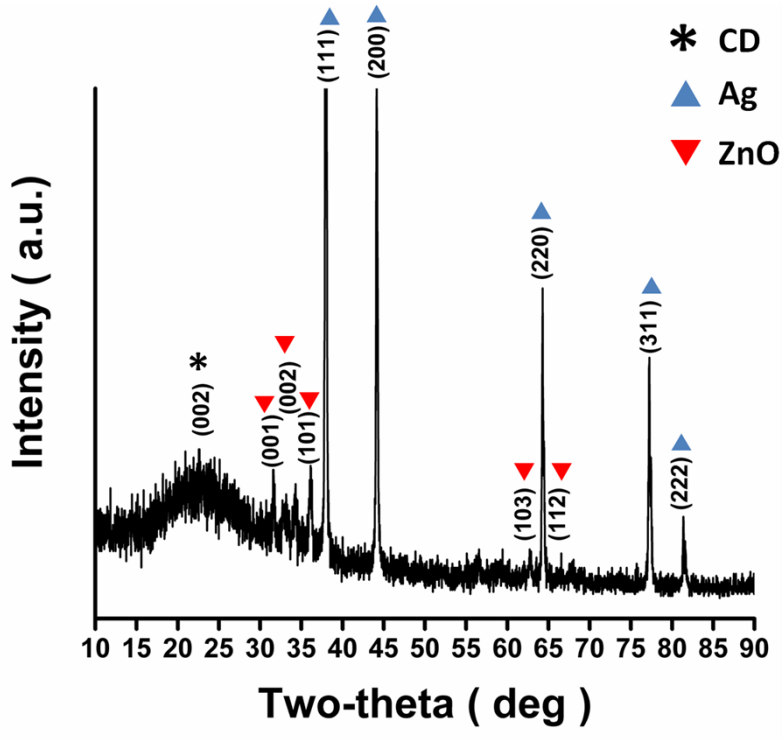


Fig. S5. XRD spectra of CD-Ag@ZnO NC.

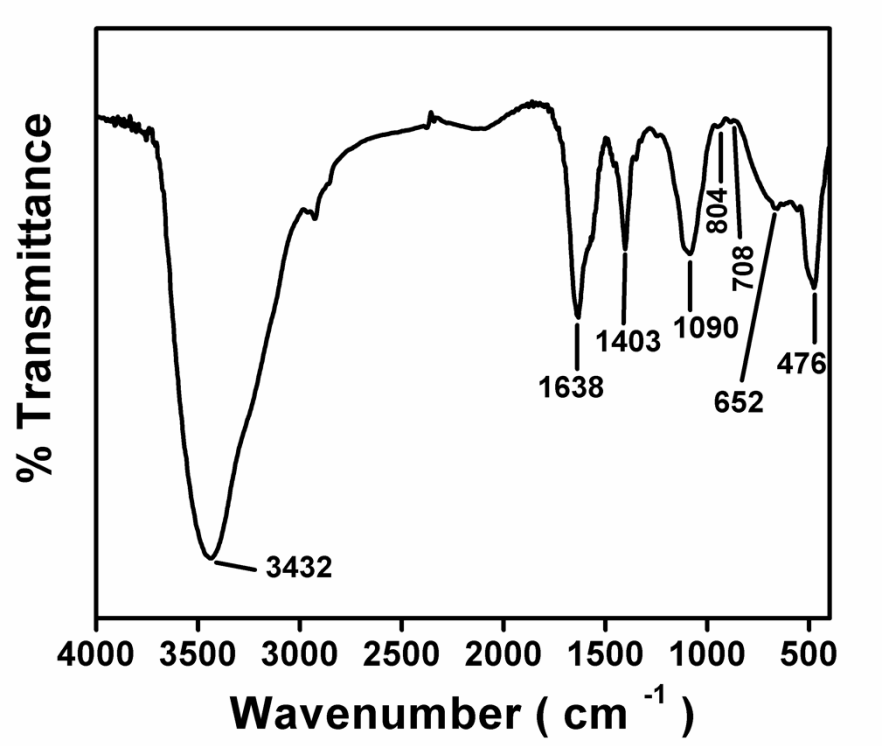


Fig. S6. FTIR spectra of CD-Ag@ZnO NC.

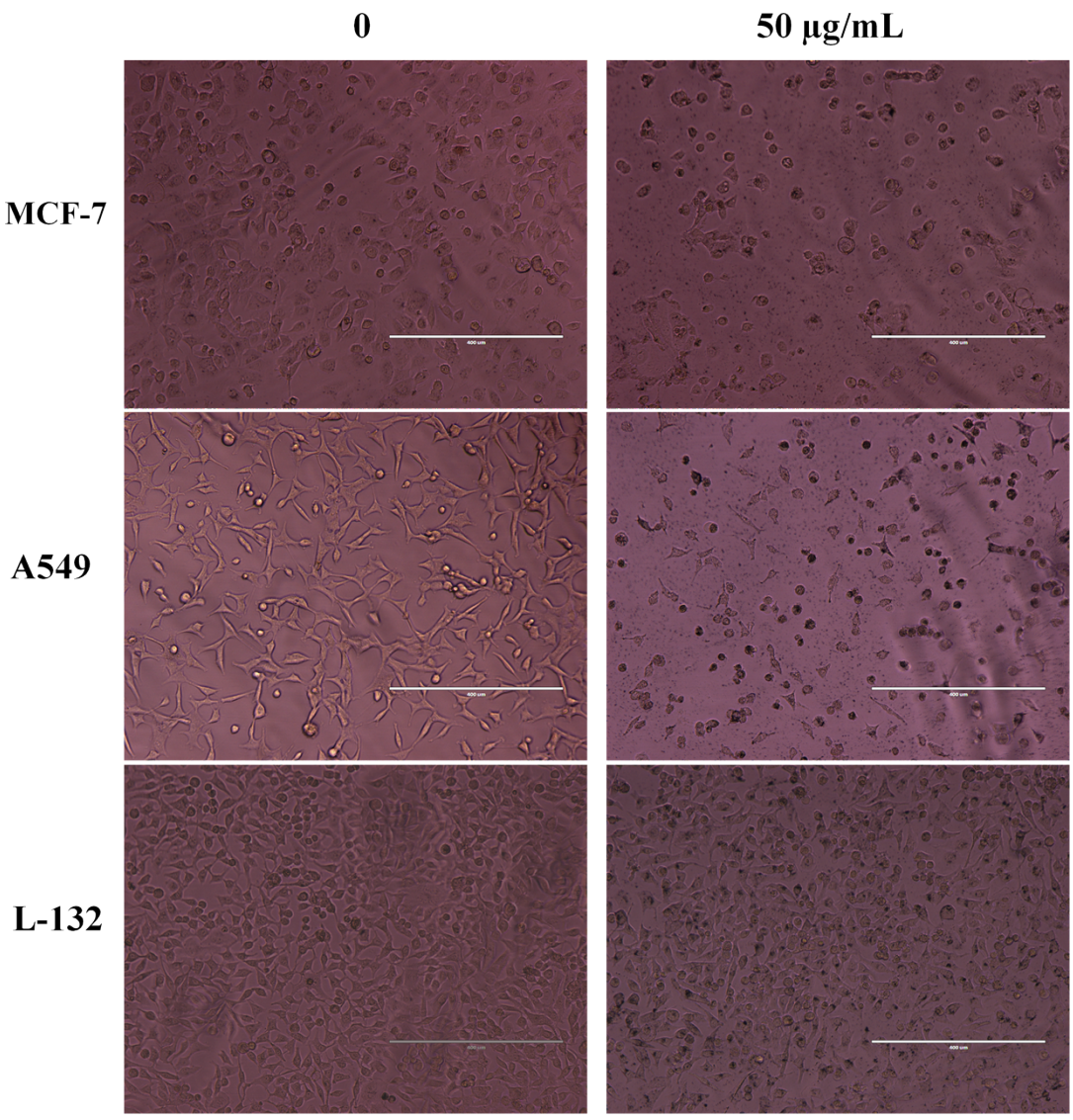


Fig. S7. Bright field microscopic images. Scale bar: 400 µm.

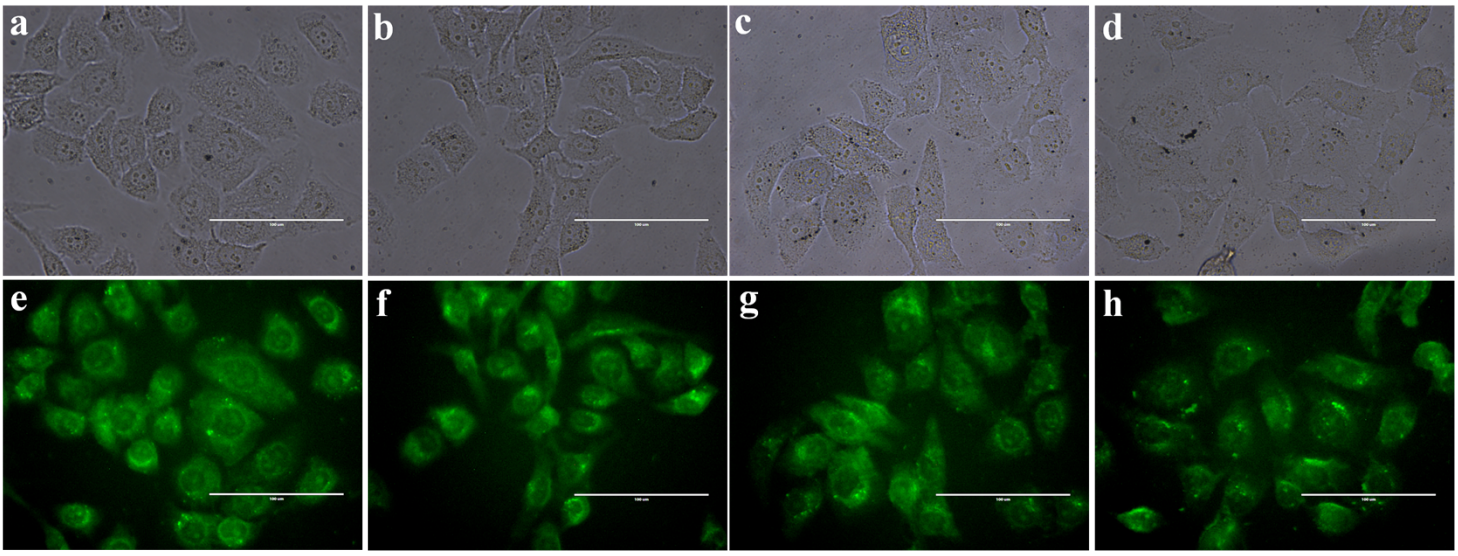


Fig. S8. Fluorescence microscopic images depicting the cellular uptake in L-132 cells. a,e) CDs and b,f) 20 µg/mL, c,g) 50 µg/mL , d,h) 70 µg/mL CD-Ag@ZnO NC treated L-132 cells. The images in the upper panel are corresponding bright field images.

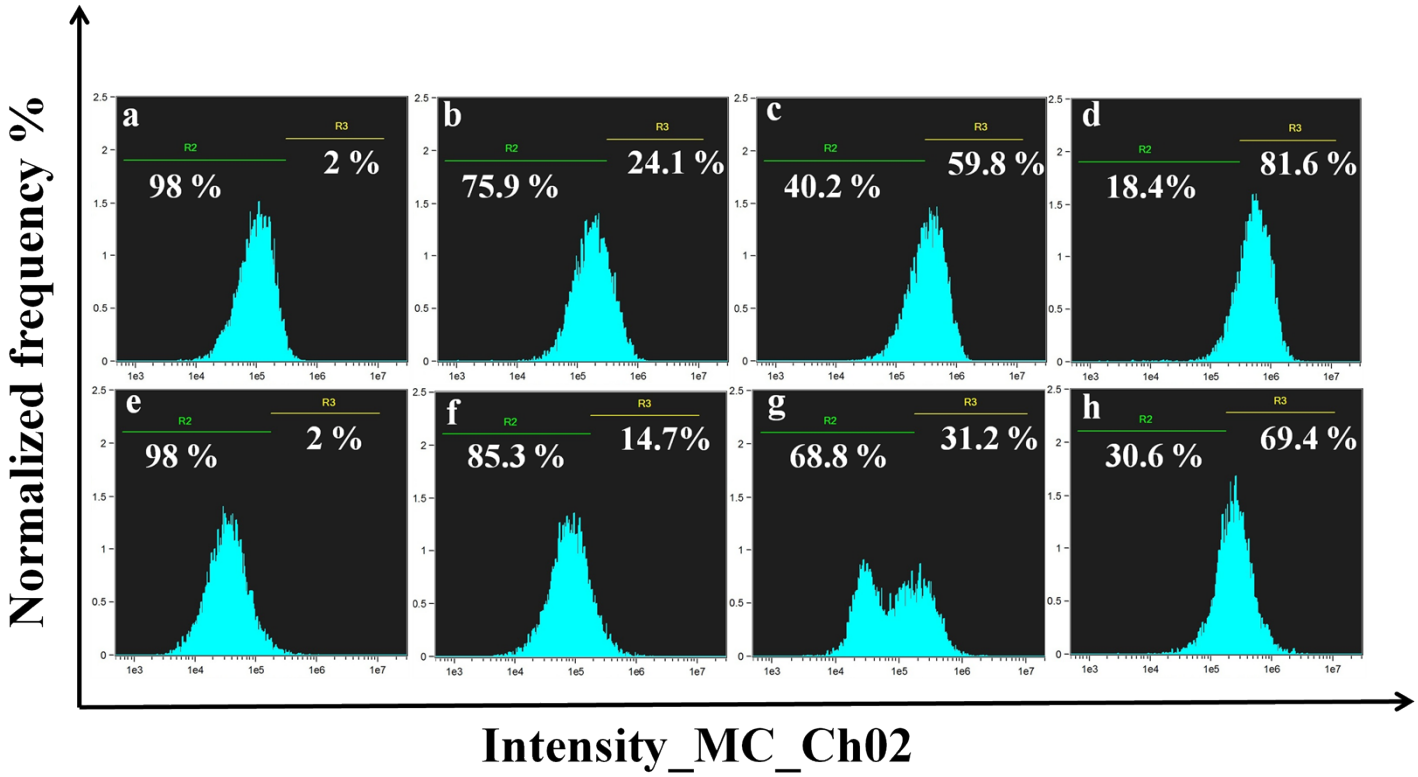


Fig. S9. Flow cytometric analysis of ROS production in MCF-7 and A549 cells. Upper panel: (a) untreated and (b) 20 µg/mL, (c) 50 µg/mL, (d) 70 µg/mL Ag@ZnO treated MCF-7 cells. Lower panel: (e) untreated and (f) 20 µg/mL, (g) 50 µg/mL, (h) 70 µg/mL Ag@ZnO treated A549 cells.

Gene	Primers
Beta-actin	Forward: 5' CTGTCTGGCGGCACCACCAT 3' Reverse : 5' GCAACTAAGTCATAGTCCGC 3'
p53	Forward: 5' TGGCCCCTCCTCAGCATCTTAT 3' Reverse : 5' GTTGGGCAGTGCTCGCTTAGTG 3'
Caspase 3	Forward : 5' TTCAGAGGGGATCGTTGTAGAAGTC 3' Reverse : 5' CAAGCTTGTCGGCATACTGTTTCAG 3'
C-myc	Forward : 5' CCAGGACTGTATGTGGAGCG 3' Reverse : 5' CTTGAGGACCAGTGGGCTGT 3'
Bax	Forward : 5' AAGCTGAGCGAGTGTCTCAAGCGC 3' Reverse : 5' TCCCGCCACAAAGATGGTCACG 3'
Bad	Forward : 5' CCTTTAAGAAGGGACTTCCTCGCC 3' Reverse : 5' ACTTCCGATGGGACCAAGCCTTCC 3'
Bcl-xl	Forward : 5' ATGGCAGCAGTAAAGCAAGC 3' Reverse : 5' CGGAAGAGTTCATTCACTACCTGT 3'
Bcl-2	Forward : 5' TCCGCATCAGGAAGGCTAGA 3' Reverse : 5' AGGACCAGGCCTCCAAGCT 3'

Table S3. Forward and reverse primer sequences for various apoptotic signaling genes.