Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

One Step Synthesis of Maltose Functionalized Red Fluorescent Ag Cluster for Specific Glycoprotein Detection and Cellular Imaging Probe

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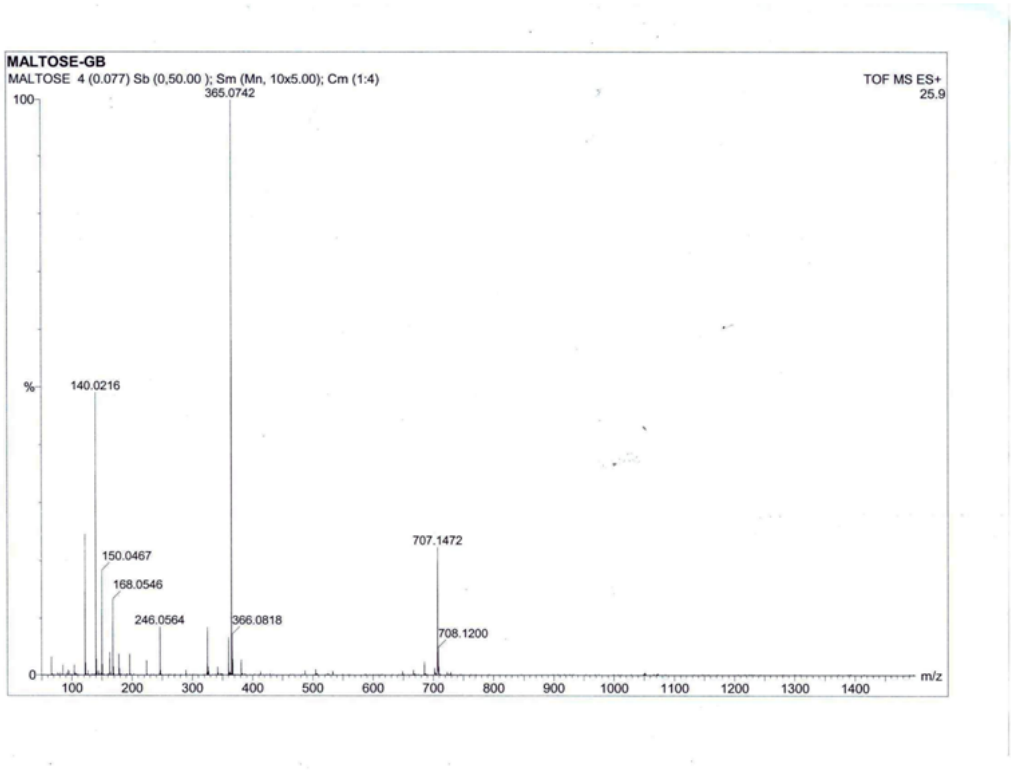

Figure S1: HR-Mass spectrum of maltose. The identifications of different peaks are as follows: 365.0742 (maltose + Na), 707.1472 (tetramer of glucose + K + $2H^+$)

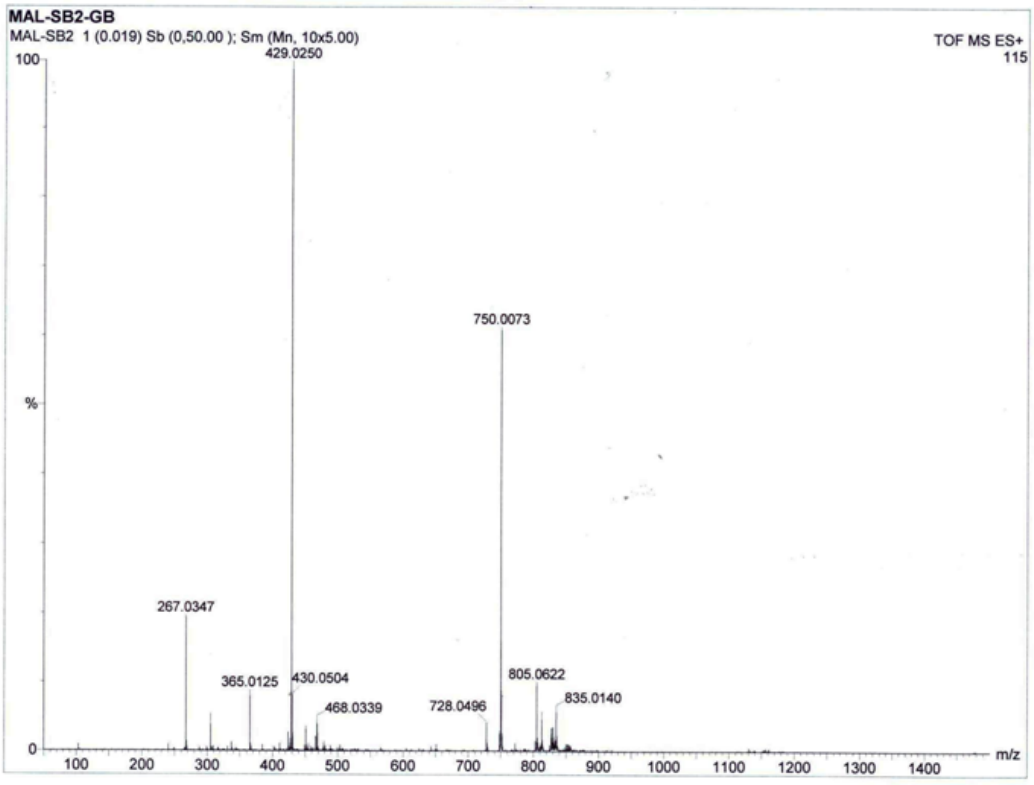

Figure S2: HR-Mass spectrum of cysteamine modified maltose (maltose-SH). The identifications of different peaks are as follows: 267.0347 (glucose-SH + Na + 3H), 429.0250 (Maltose-SH +Na^++$3H^+$), 468.03 (429+K) 726.0406 (tetramer of glucose-S^-), 750.007 (tetramer of glucose-SH + Na), 805 (Dimer of maltose SH + H).

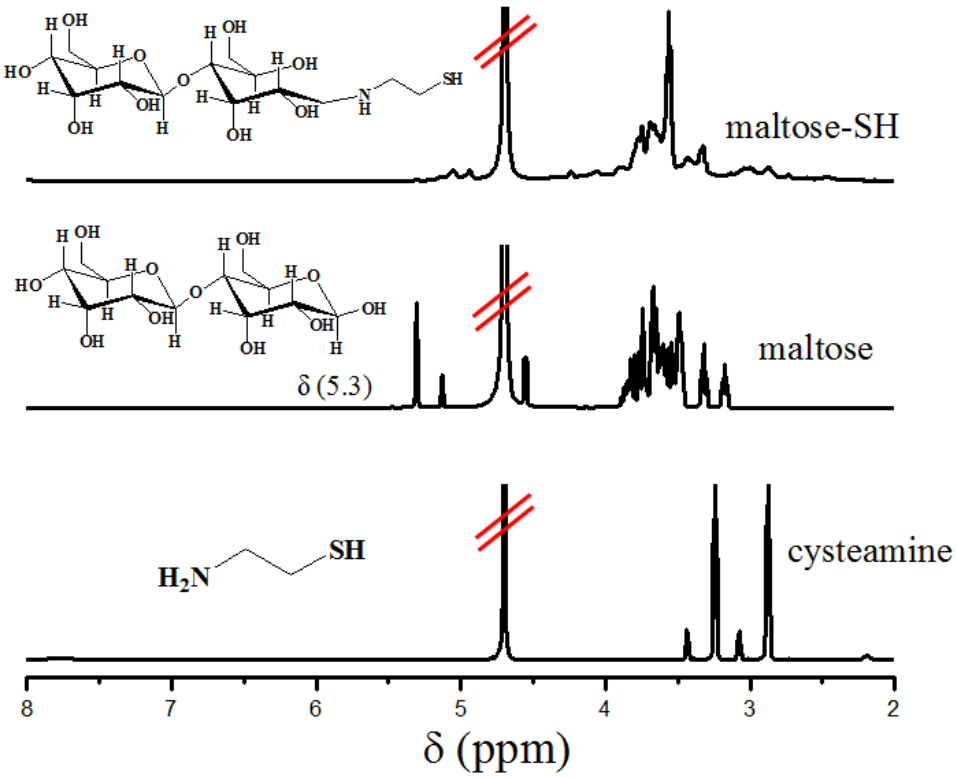

Figure S3: NMR spectra of cysteamine, maltose and cysteamine modified maltose molecule (maltose-SH). NMR protons signal of δ value between 3.25 and 4 is due to maltose molecule and absence of any peak at δ value of 5.3 due to protons at reducing end of maltose in maltose-SH. This result indicates successful synthesis of maltose-SH from cysteamine and maltose by reductive amination.

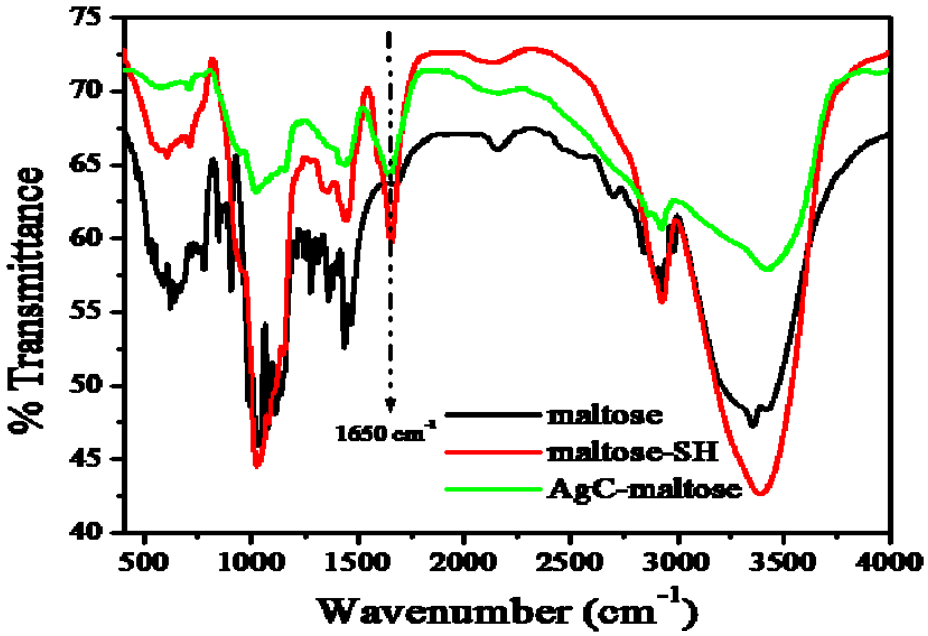

Figure S4: FT-IR spectra of maltose, cysteamine modified maltose and maltose functionalized red fluorescent silver cluster (AgC). Peak at 1650 cm^{-1} shows the N-H bending vibration of secondary amine of cysteamine modified maltose (maltose-SH) which is present in cysteamine modified maltose as well as maltose functionalized red fluorescent AgC. It confirms that AgC is stabilized by maltose-SH.

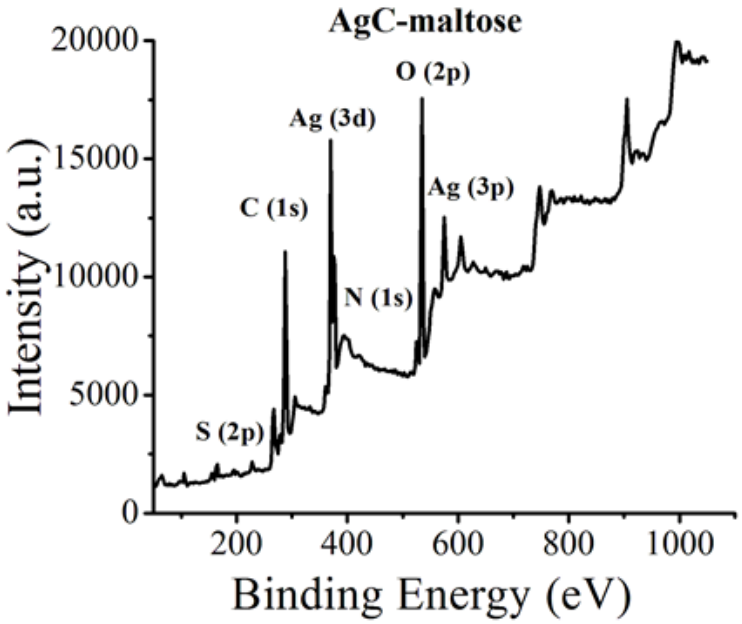

Figure S5: The raw XPS data of maltose functionalized red fluorescent silver cluster (AgC) shows signals corresponding to carbon, nitrogen, oxygen, sulphur and silver.

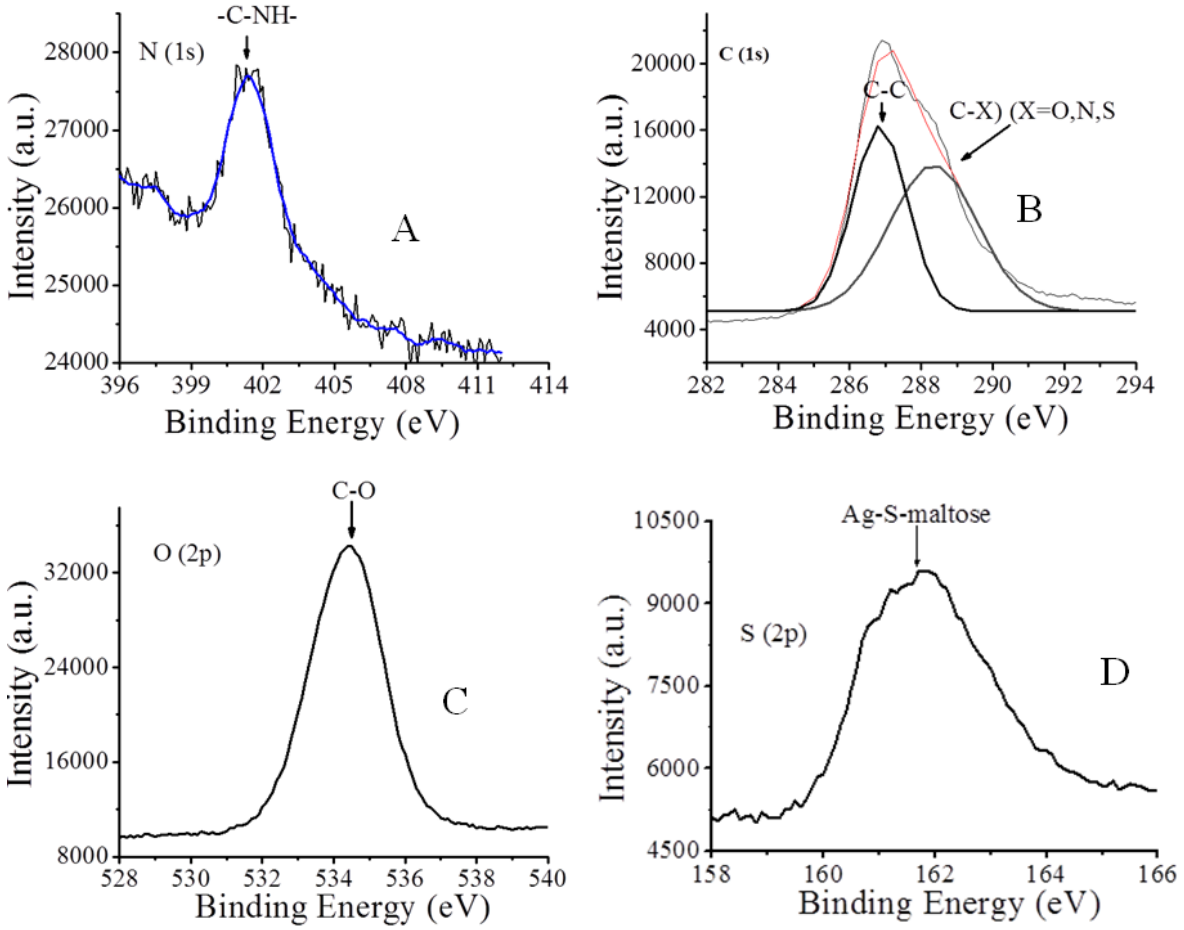

Figure S6: XPS spectra of maltose functionalized red fluorescent silver cluster (AgC). A) N 1s spectrum shows a peak centered at 401.5 eV peaks is due to N1s binding energy of secondary amine of maltose-SH. B) Peaks at 286.9 is attributed to C 1s electron binding energy of C-C bond and 288.4 eV is due to C 1s electron binding energy of C-X (X=O, N, S) bond. C) O 1s spectrum shows a peak at 534.5 eV is due to O 2p electron binding energy of C-OH/C-O-C bonds of maltose carbohydrate moiety. D) S 2p spectrum shows a peak at161.75 for silver bound S^- of AgC.

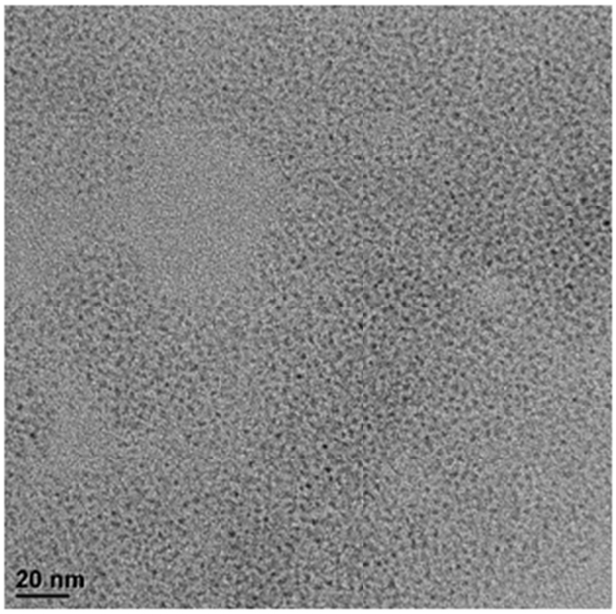

Figure S7: Low resolution TEM image of maltose functionalized red fluorescent AgC.

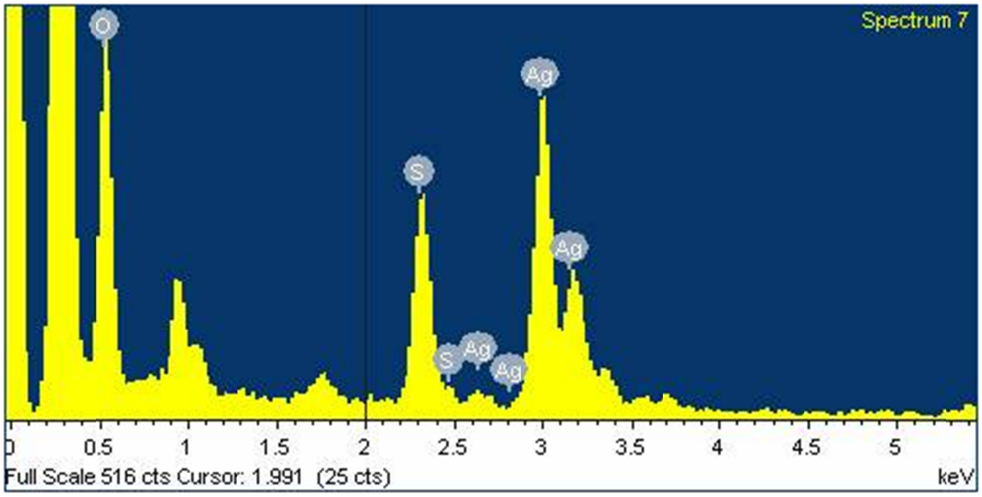

Figure S8: EDS of maltose functionalized red fluorescent silver cluster (AgC) showing the presence of Ag and S atom.

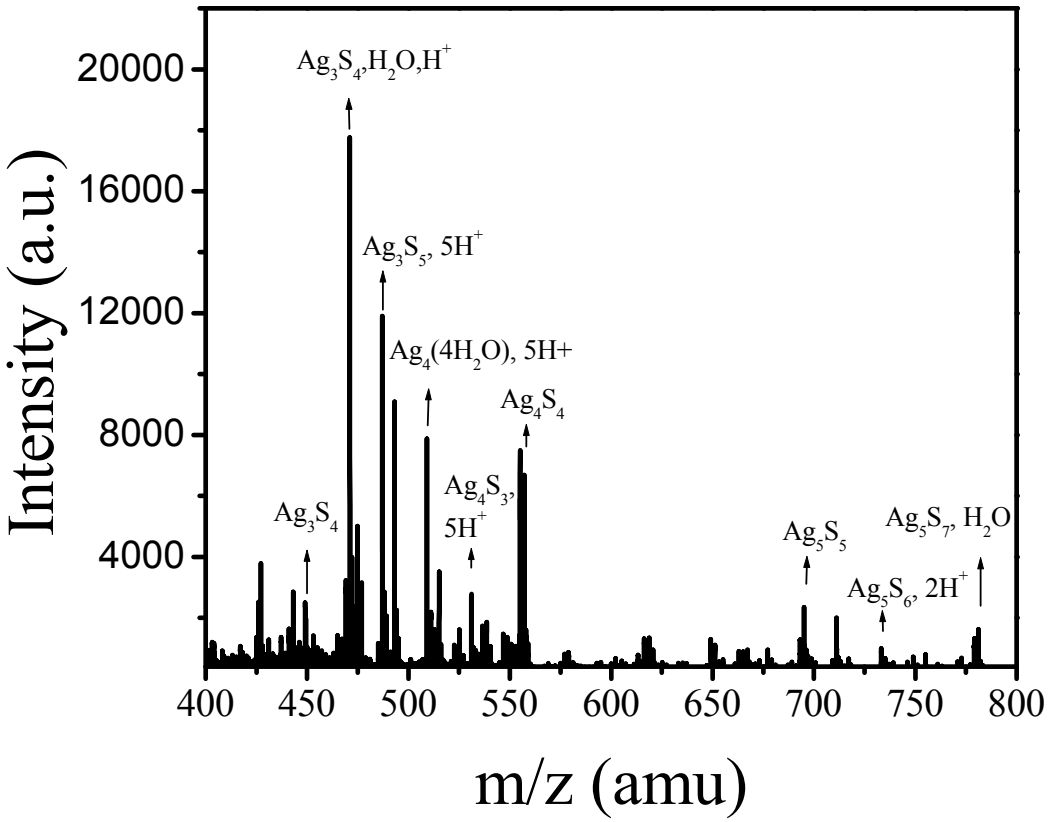

Figure S9: MALDI-TOF spectra of maltose functionalized red fluorescent AgC. The identifications of different cluster peaks associated with silver-sulphide and solvent molecules are as follows: 451.6 (Ag_3S_4), 470.6 (Ag_3S_4, H_2O, H^+), 487.6 (Ag_3S_5, $5H^+$), 508.47 ($Ag_4(4H_2O)$, $5H^+$), 532.47 (Ag_4S_3, $5H^+$), 559.47 (Ag_4S_4), 699.34 (Ag_5S_5), 733.34 (Ag_5S_6, $2H^+$), 781.34 (Ag_5S_7, H_2O).

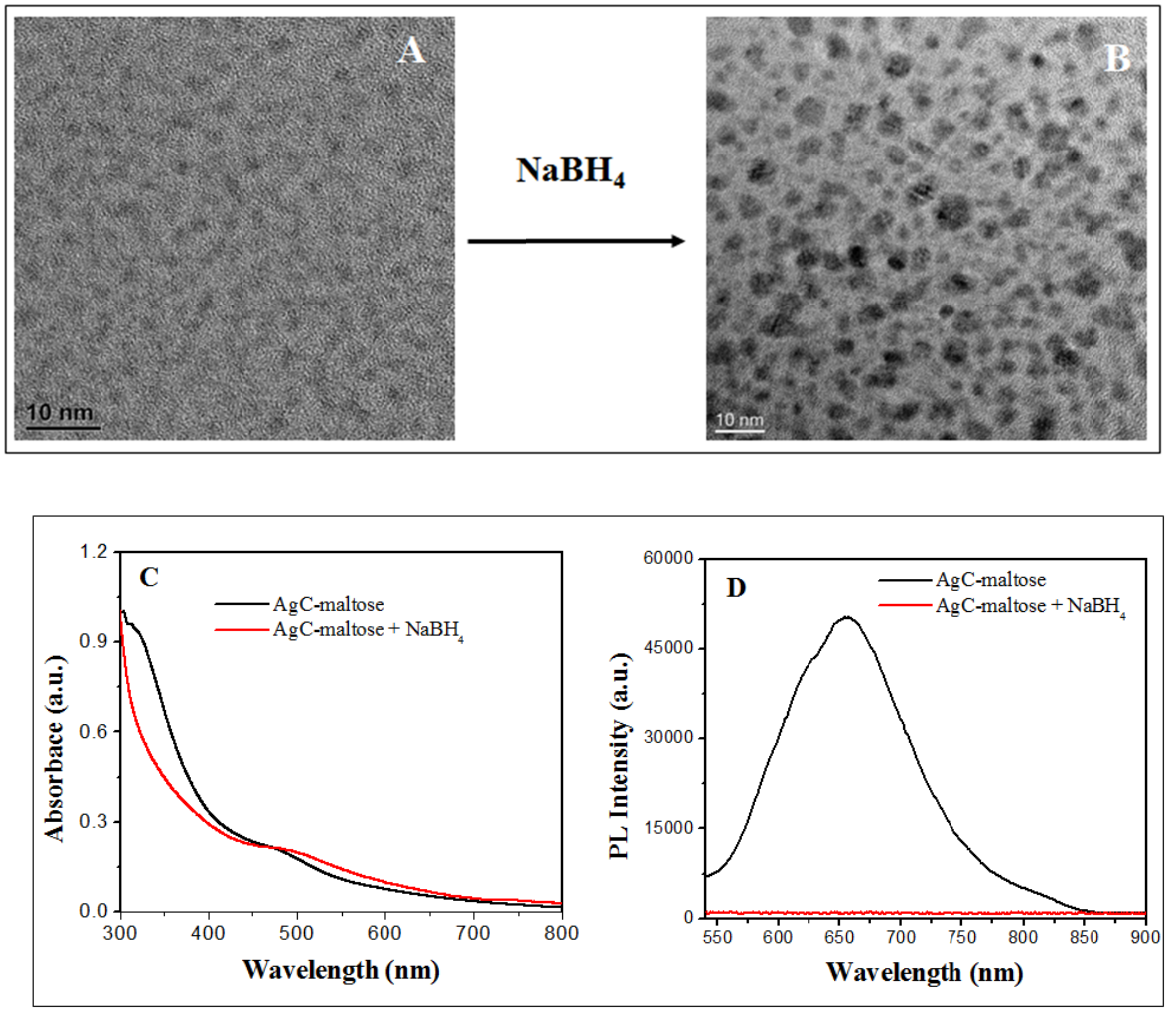

Figure S10: TEM investigation of influence of borohydride on maltose functionalized red fluorescent AgC (Figure A & B). Upon treatment of sodium borohydride on maltose functionalized red fluorescent AgC produces large Ag cluster/nanoparticle. Solution of red fluorescent Ag cluster is mixed with borohydride and TEM sample is measured after 2-3 hours of adding borohydride. It proved that in silver cluster Ag remains as Ag^{+1}. Optical investigation of effect of borohydride on maltose functionalized red fluorescent AgC (Figure C & D). Characteristics absorption of red fluorescent AgC at ~480 nm is converted to characteristic plasmonic of silver nanoparticle at ~510 nm (figure C). Characteristics fluorescence property of red fluorescent AgC also vanished upon treatment of sodium borohydride (figure D).

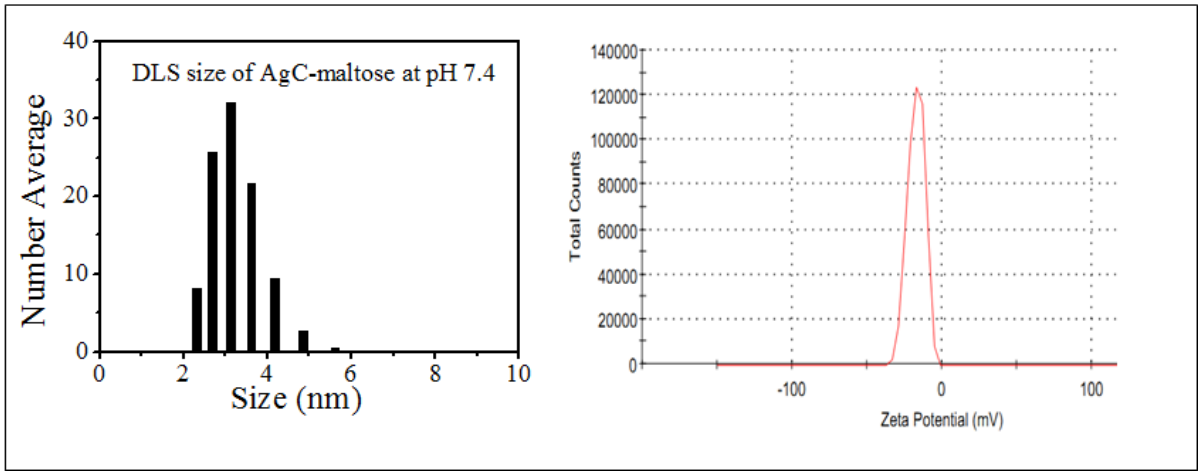

Figure S11: Dynamic light scattering based hydrodynamic size and Zeta potential value of maltose functionalized red fluorescent AgC.

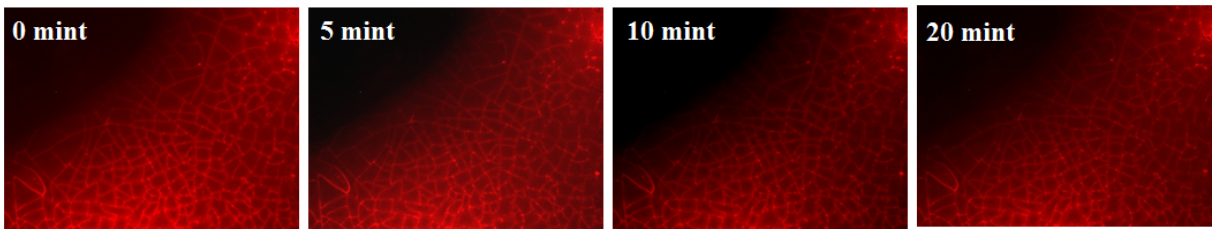

Figure S12: Photo stability of maltose functionalized red fluorescent AgC under continuous green excitation (Ex at 510 nm). Fluorescence images are taken by fluorescence microscope on drop casing the AgC on glass slide under continuous excitation of green light at different interval time (e.g. 0 mints, 5 mints, 10 mints and 20 mints) with exposer time 1.3 seconds. The images show that fluorescence property of silver cluster is stable under the continuous excitation of green light.

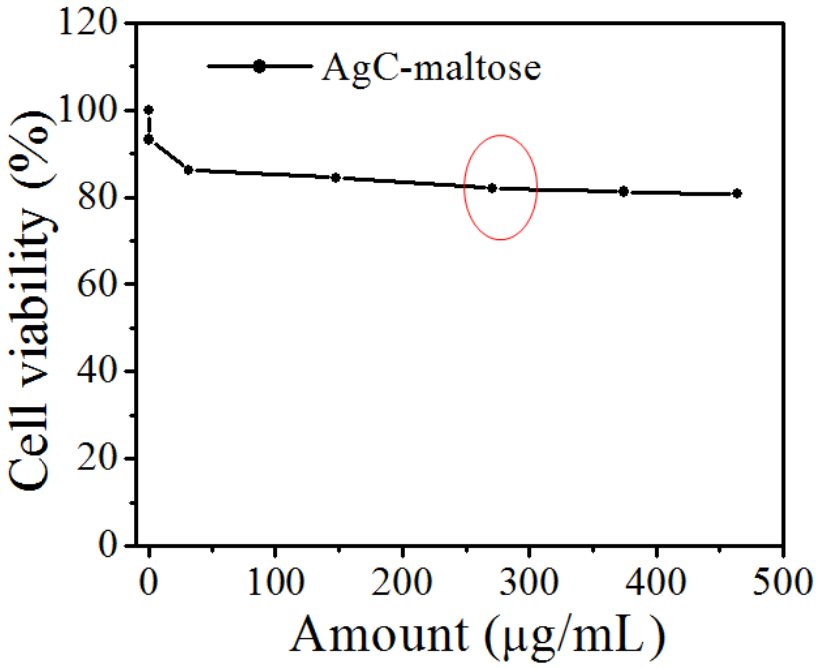

Figure S13: Cell Viability test (MTT assay) of maltose functionalized red fluorescent silver cluster (AgC). Point inside the circle shows the condition at which cell labeling study was carried out. It was 270 µg/mL and it this condition cell viability was ~85%.

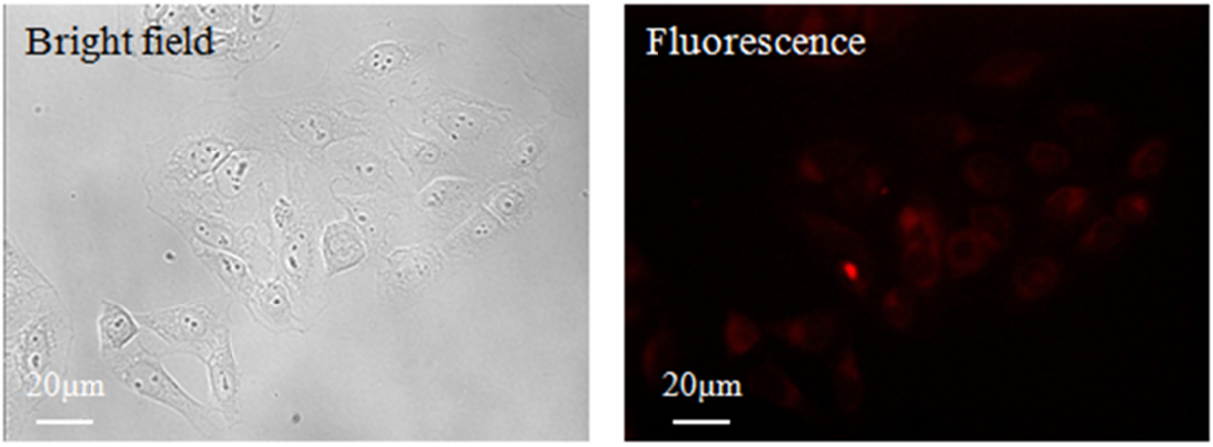

Figure S14: Fluorescence microscopic image of HeLa cell labeled with maltose functionalized red fluorescent silver cluster.

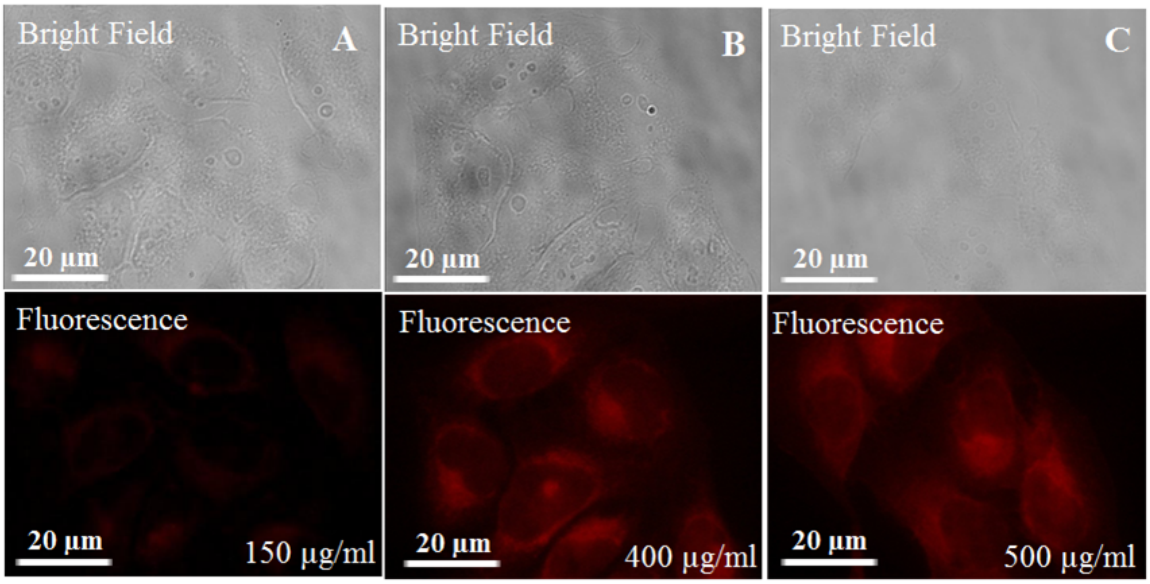

Figure S15: Labeling of HeLa cell by maltose functionalized red fluorescent AgC at various dose/concentration (A= 150 µg/mL, B= 400 µg/mL, C= 500 µg/mL). Upper panel shows the bright field images of labeled cells and lower panel shows the corresponding images under fluorescence microscope.