Electronic supplementary information (ESI) for Nanoscale
This journal is © The Royal Society of Chemistry 2012

Protein-encapsulated gold cluster aggregates: The case of lysozyme†

Ananya Baksi,[a] Paulrajpillai Lourdu Xavier,[a] Kamalesh Chaudhary,[a,b] N. Goswami,[c] S. K. Pal[c] and T. Pradeep[a*]

[a]DST Unit of Nanoscience, Department of Chemistry, Indian Institute of Technology Madras, Chennai-600036, India. *E-mail: pradeep@iitm.ac.in

[b]Department of Biotechnology, Indian Institute of Technology Madras, Chennai-600036, India

[c]Unit of Nanoscience and Technology, Department of Chemical, Biological and Macromolecular Sciences, Satyendra Nath Bose National Centre for Basic Sciences, Block JD, Sector III, Salt Lake, Kolkata 700 098, India

Electronic Supplementary Information 1

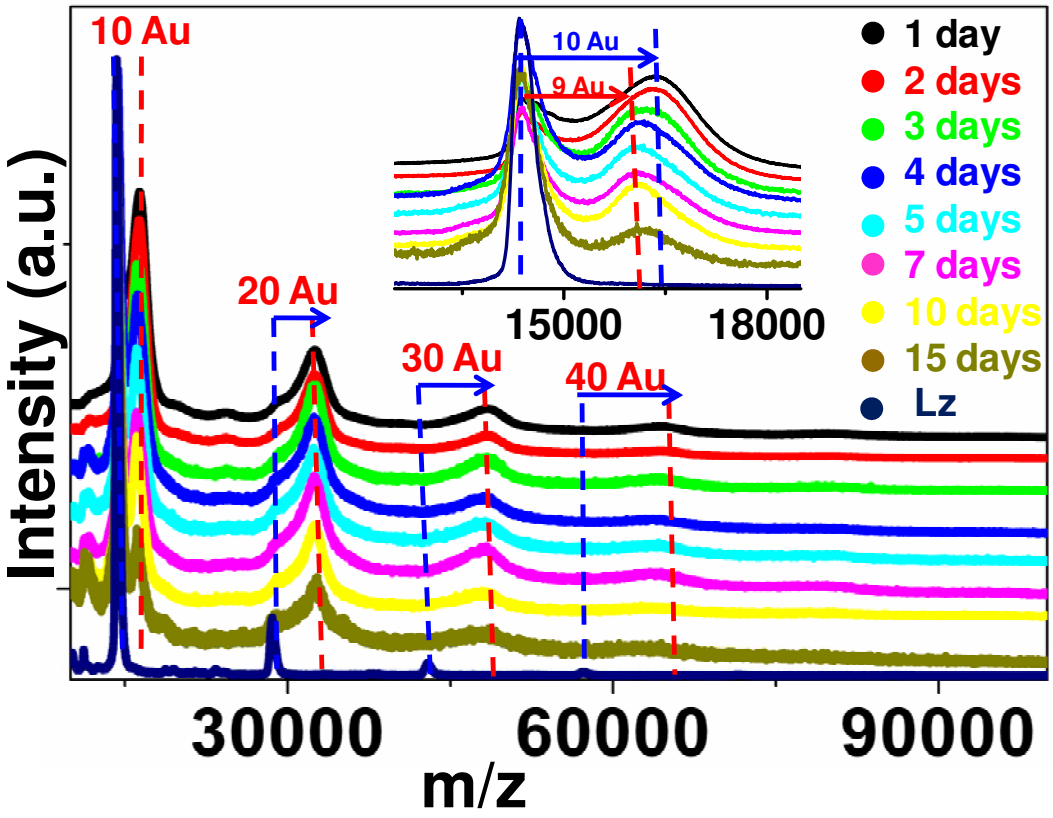

Fig. S1† Time dependent MALDI MS of Lyz: Au^{3+} (molar ratio of 1:4) over 15 days time window. A linear dependence of Au ion uptake is seen for the oligomerized Lyz. While monocation of Au_{QC}@single protein shows a separation of 10 Au atoms from the parent protein peak, oligomerized Lyz show separation of n×10 (where n=2, 3, 4,…) from their parent oligomerized Lyz where n is the aggregation number. Inset shows the monomer region.

Electronic Supplementary Information 2

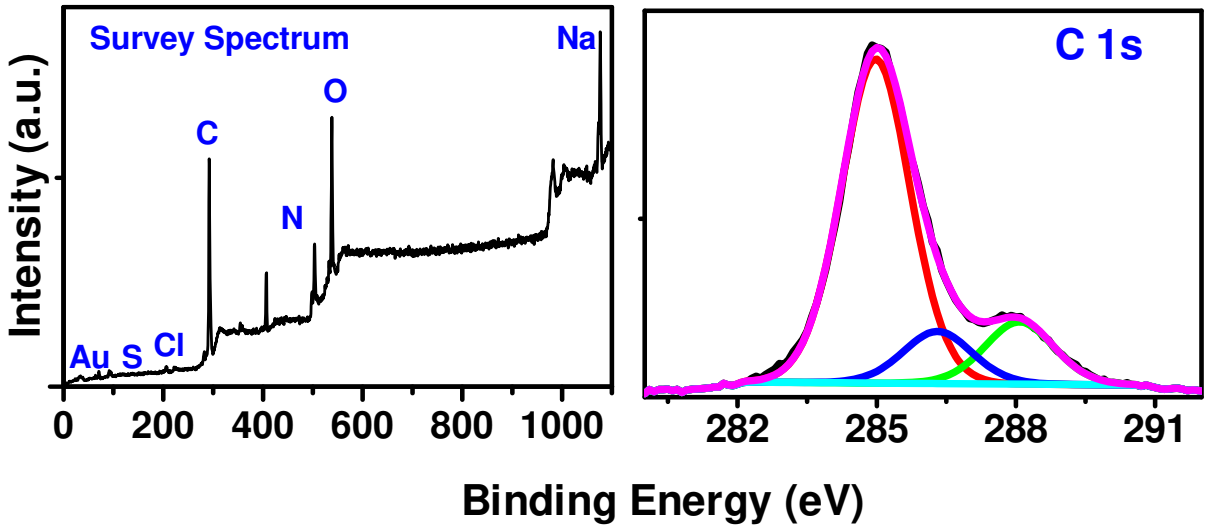

Fig. S2† The survey spectrum is characterized by peaks due to carbon, oxygen, nitrogen, sodium, chlorine, gold and sulphur. Carbon 1s binding energy for the main peak is taken to be 285 eV and other binding energy values have been determined.

Electronic Supplementary Information 3

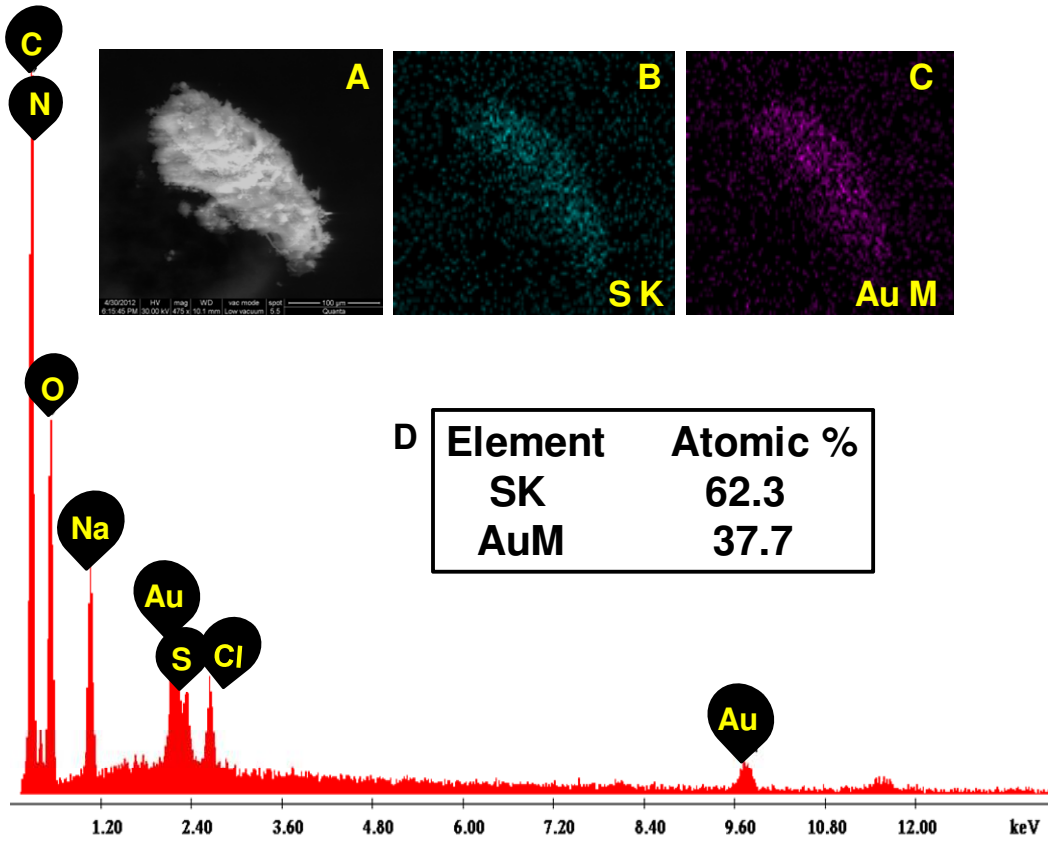

Fig. S3† SEM EDAX spectra of Au_{QC}@Lyz using Lyz: Au^{3+} ratio 1:4. Inset A, is the SEM image of the sample. B and C are EDAX mapping of SK and AuM corresponding to A. D is the quantification of S and Au in the sample.

Electronic Supplementary Information 4

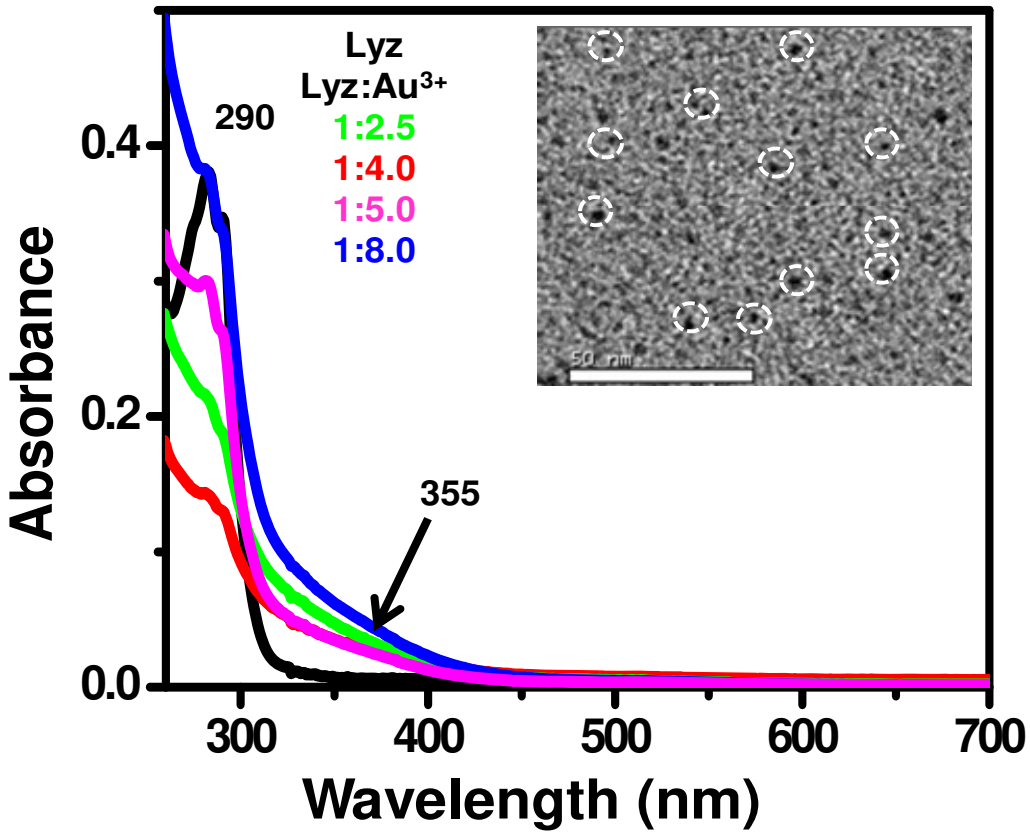

Fig. S4† Concentration dependent UV-Vis spectra of as-synthesized Au_{QC}@Lyz. The peak at 290 nm is assigned to the protein. A characteristic hump near 355 nm is also seen. There is no specific feature of cluster core in these spectra. In the inset, HRTEM image is shown, clusters are sized between 1.1±0.1 nm. There is no feature corresponding to the formation of bigger plasmonic nanoparticles.

Electronic Supplementary Information 5

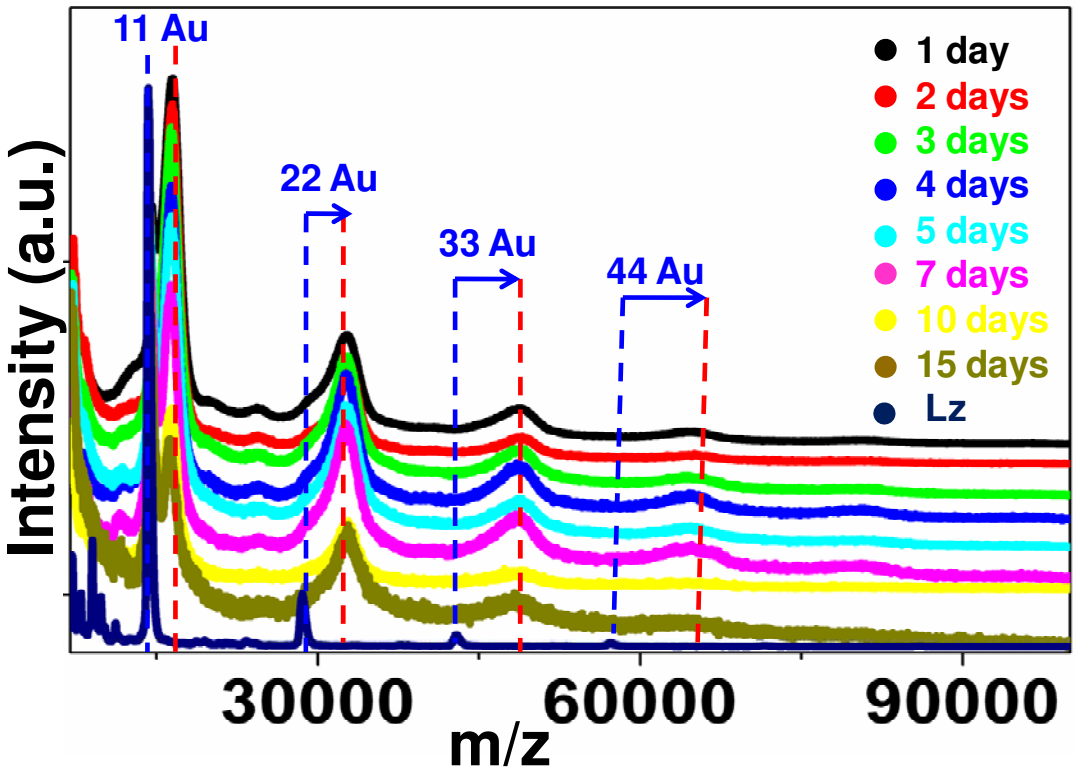

Fig. S5† Time dependent MALDI MS of Lyz: Au^{3+} (molar ratio 1:5) over 15 days time window. A linear dependence of Au uptake is seen for the oligomers. While monomer shows a separation of 11 Au atoms from the parent protein peak, oligomers show separation of n×11 (where n = 2, 3, 4…).

Electronic Supplementary Information 6

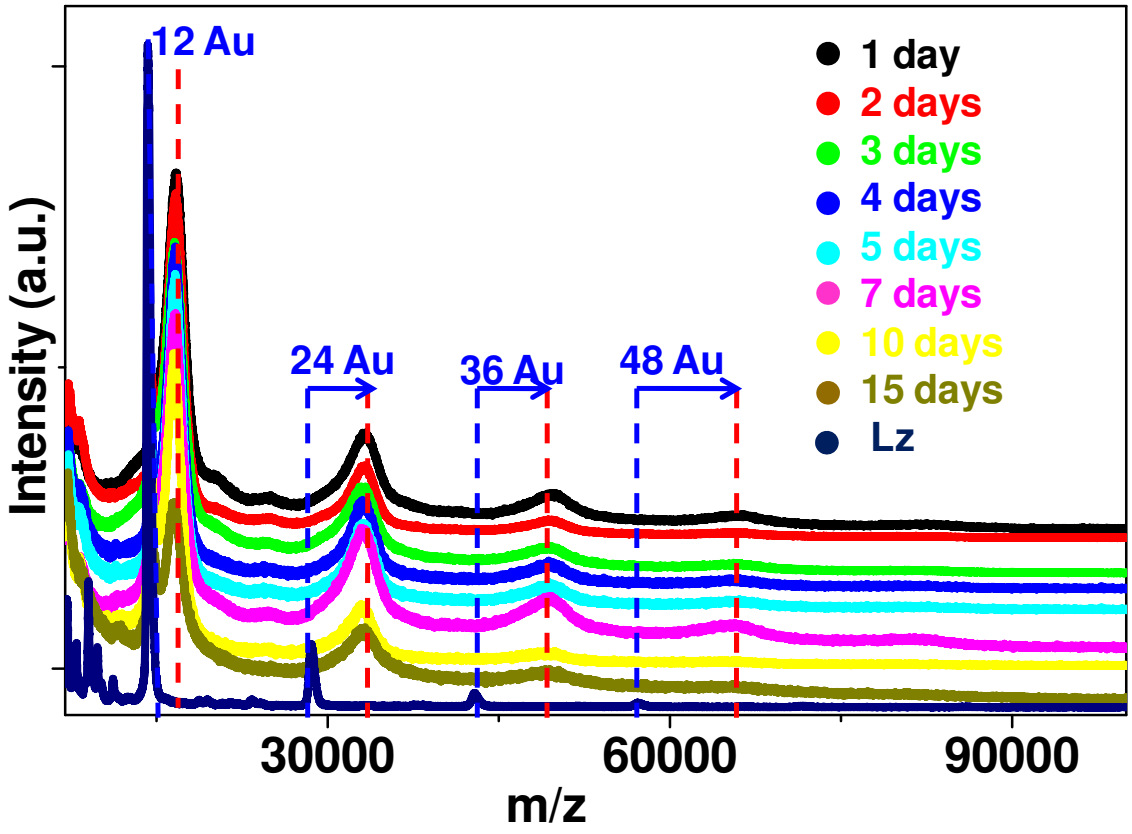

Fig. S6† Time dependent MALDI MS of Lyz: Au^{3+} (1:8 molar ratio) over 15 days time window. A linear dependence of Au uptake is seen for the oligomers. While monomer shows a separation of 12 Au atoms from the parent protein peak, oligomers show separation of n×12 (where n=2, 3, 4,…).

Electronic Supplementary Information 7

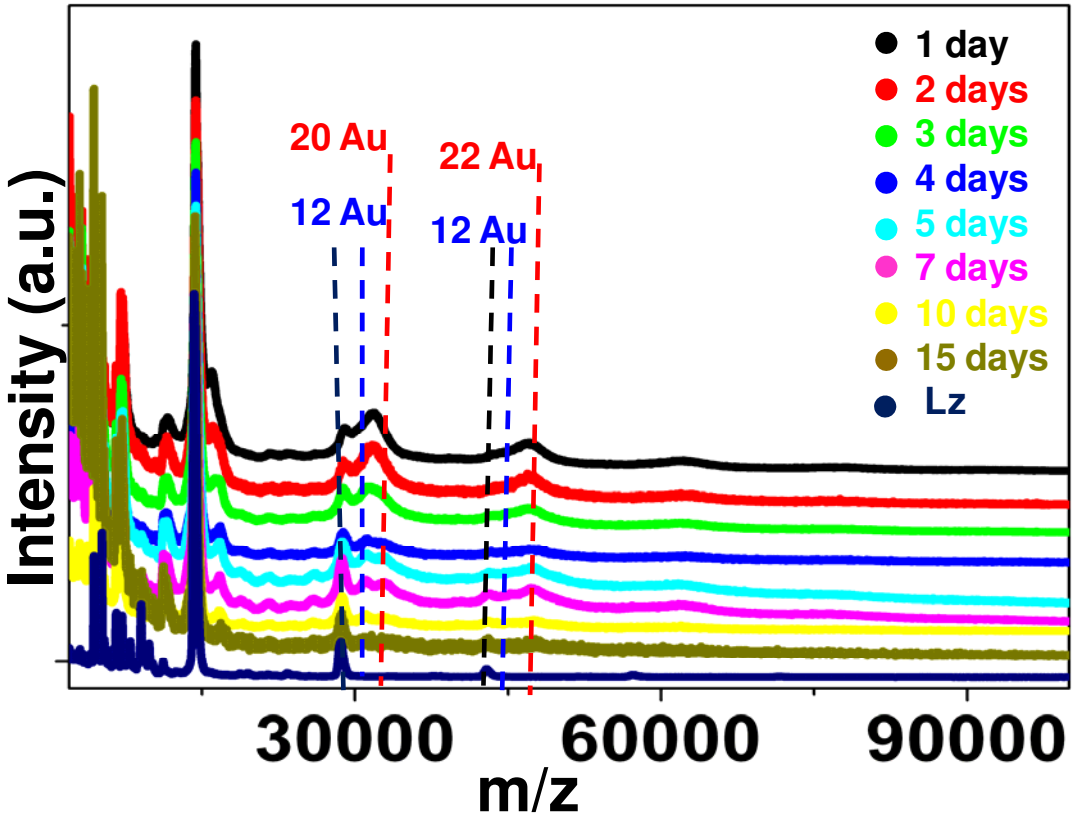

Fig. S7† Time dependent MALDI MS of Lyz: Au^{3+} (1:2.5molar ratio) over 15 days time window. A linear dependence of Au uptake is seen for the oligomers. While monomer shows a separation of 10 Au atoms, after 5 days the peak shifts to 12 Au atoms. In the dimer and trimer regions two distinct peaks appear. For dimer, peaks are separated by 12 and 20 Au atoms while in trimer, peaks are separated by 12 and 22 Au atoms.

Electronic Supplementary Information 8

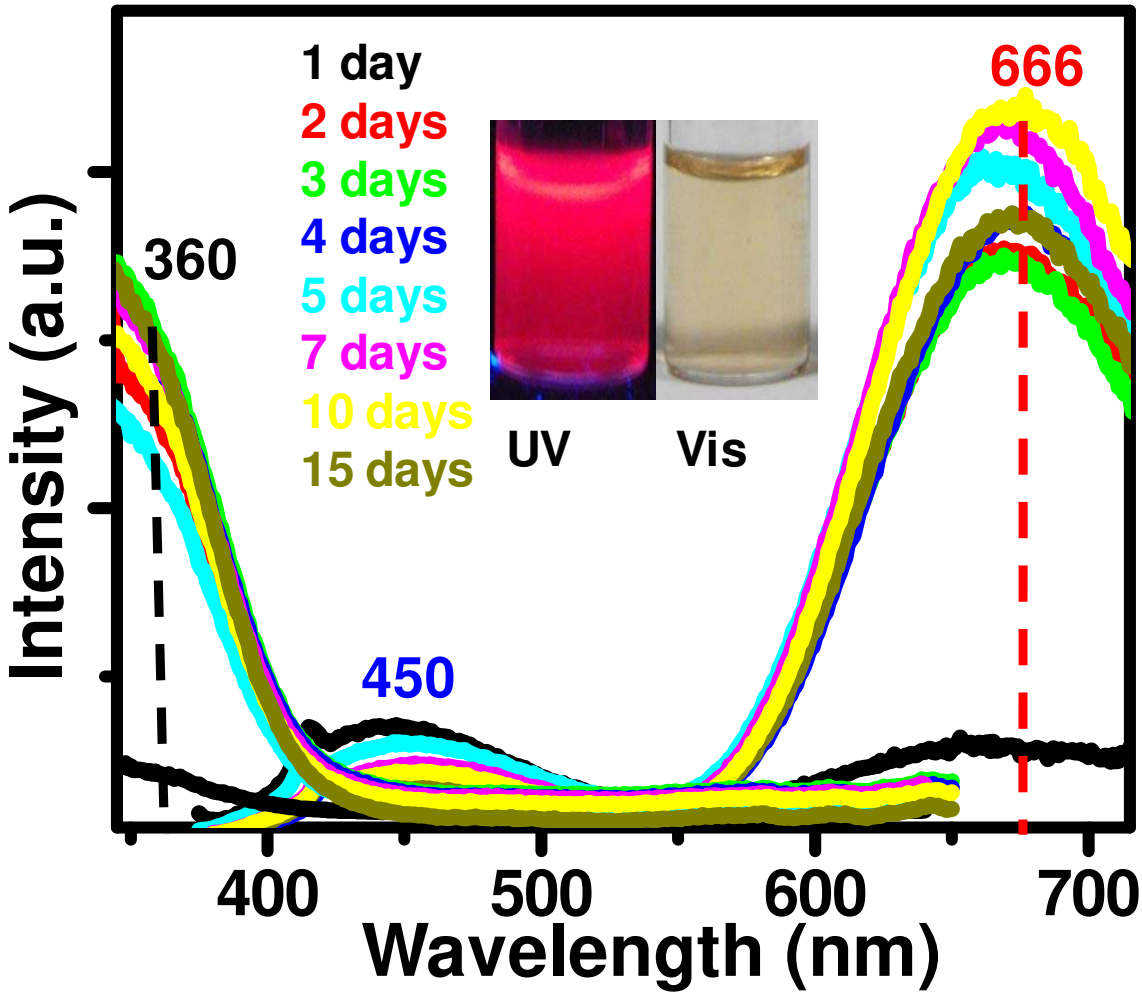

Fig. S8† Time dependent luminescence spectra of Lyz: Au^{3+} (1:5molar ratio) over 15 days time window. Upon exciting at 360 nm, the cluster emits at 666 nm. Insets show the photographs of the sample under ultra-violet and visible light.

Electronic Supplementary Information 9

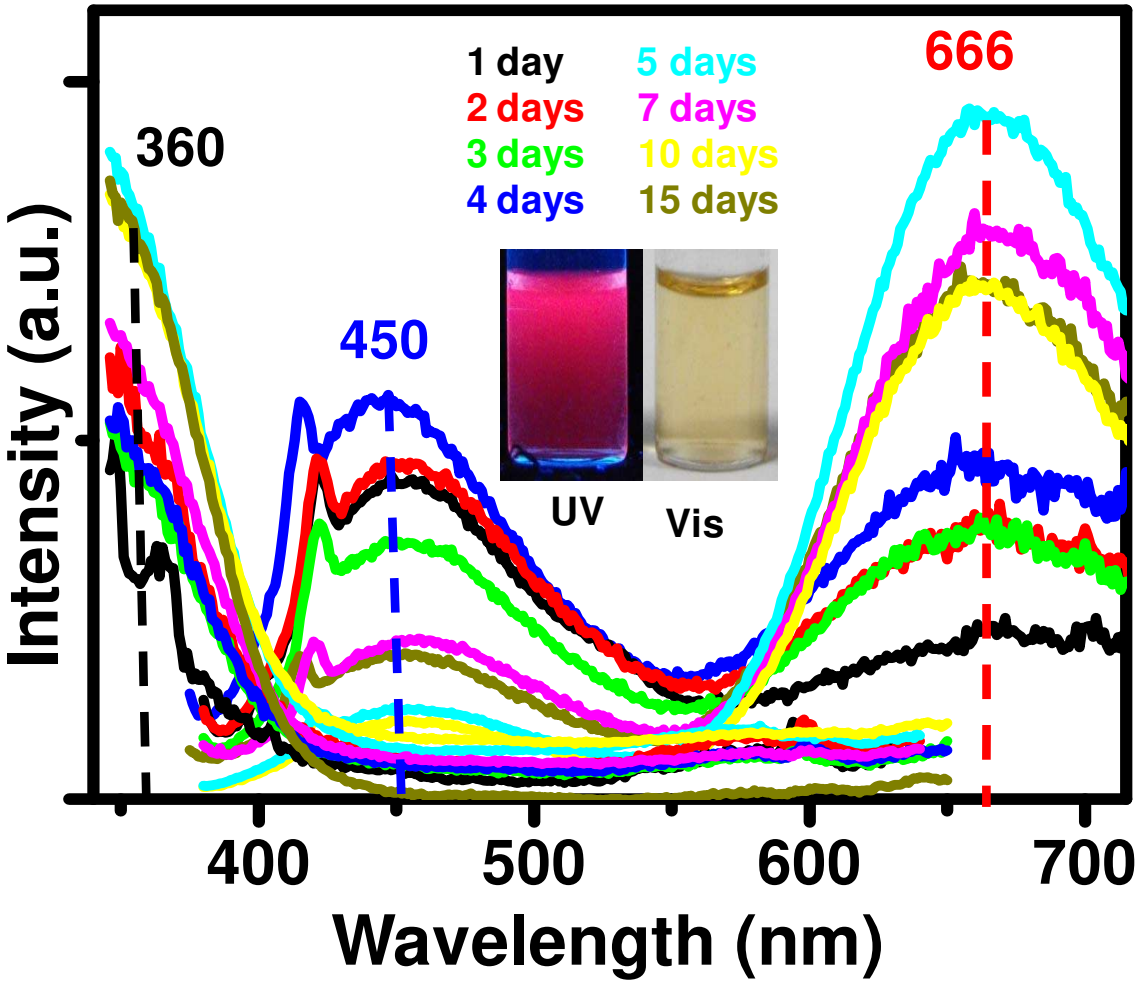

Fig. S9† Time dependent luminescence spectra of Lyz: Au^{3+} (1:8molar ratio) over 15 days time window. Upon exciting at 360 nm the cluster emits at 666 nm. Insets show the photographs of the sample under ultra-violet and visible light.

Electronic Supplementary Information 10

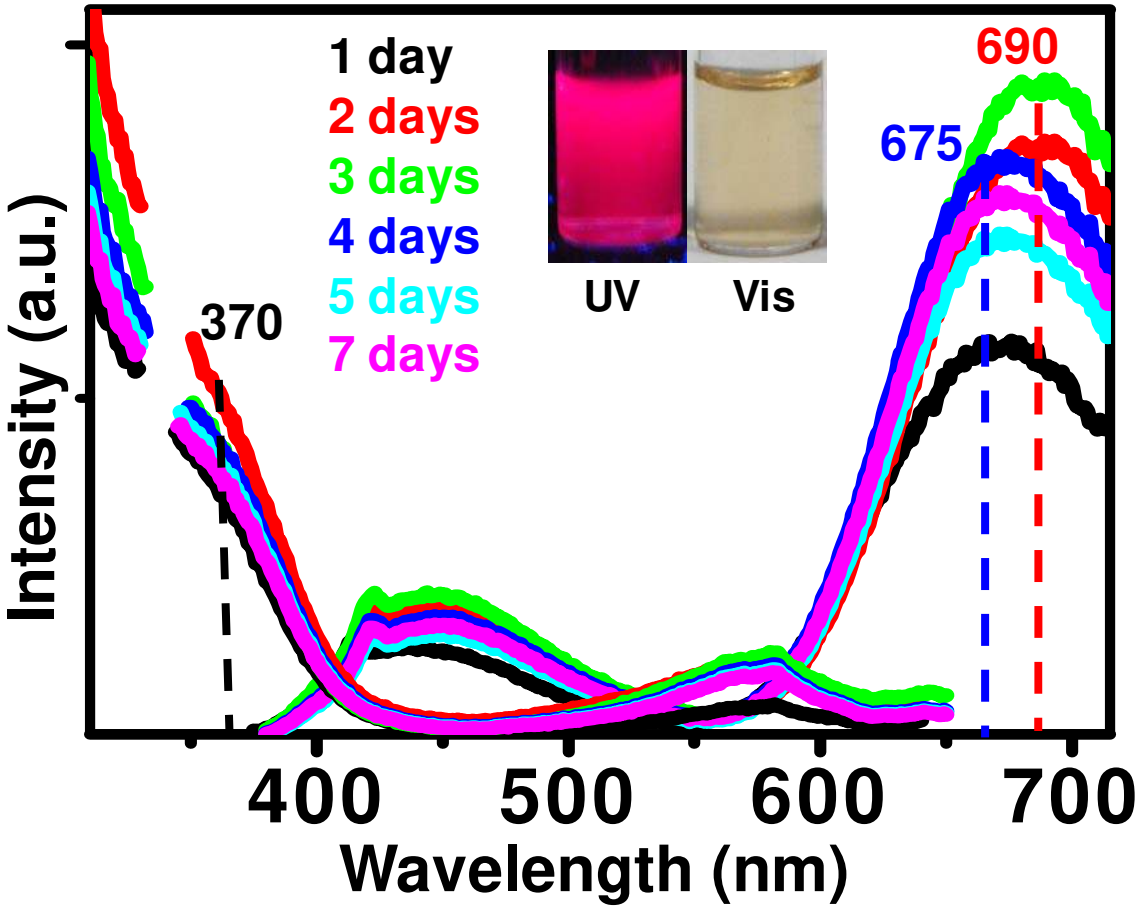

Fig. S10† Time dependent luminescence spectra of Lyz: Au^{3+} (1:2.5 molar ratio) over 7 days time window. Upon exciting at 370 nm the cluster emits at 690 nm which again blue shifts to 675 nm upon longer time. Insets show the photographs of the sample under ultra-violet and visible light. Calculated quantum yield is 15.2%.

Electronic Supplementary Information 11

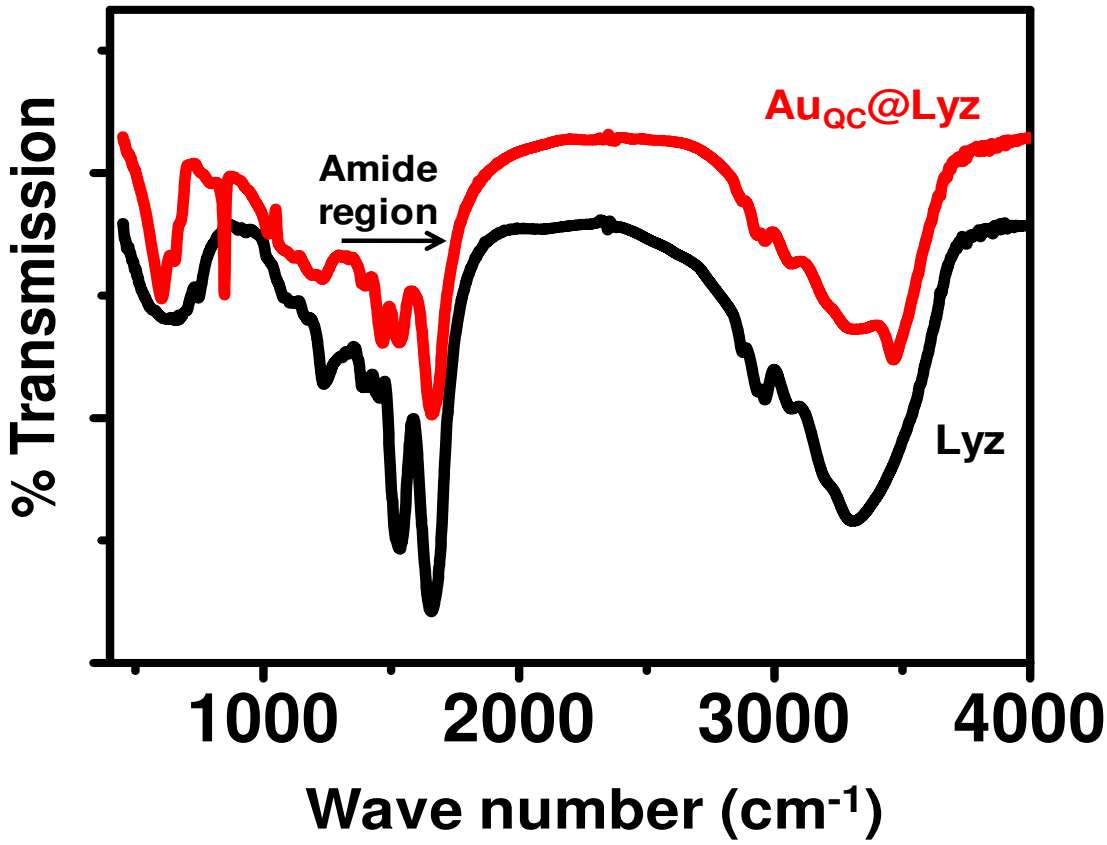

Fig. S11† Infrared (IR) spectra of Lyz and Au_{QC}@Lyz showing significant change in the amide region.