In Situ Growth of Low-Dimensional Silver Nanoclusters with their Tunable Plasmonic and Thermodynamic Behaviour

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Experiment details:

Material: The $AgNO_3$ (99.0 %) metal salt and, $NaNO_3$ (99.0%) were purchased from sigma Aldrich. Commercial soda-lime glass with composition (weight %) of 72.0% SiO_2, 14.0% Na_2O, 0.6% K_2O, 7.1% CaO, 4.0% MgO, 1.9% Al_2O_3, 0.1% Fe_2O_3, and 0.3% SO_3) and thickness of 1 mm were used. Ion exchange rout has been performed for the synthesis of Ag embedded soda lime-glass.

Method: Soda-lime glasses were poured in formic acid for 15 min to remove the impurity from surface. The poured slides were cleaned with distilled water, acetone and trichloroethylene by ultrasonication (20 KHz) for 15 min. The homogeneous mixture of 0.5% $AgNO_3$ and 95.5% $NaNO_3$ were prepared by molten piston grinding. The glass slide pieces were kept into the Alumina boat (Al_2O_3> 99%) and filled with grinded homogeneous mixture of precursors. The alumina boat transferred into the tubular furnace for Ag and Na ion exchange inside the glass slide at 390 °C for 5 min at air atmosphere. The as ion-exchanged samples were cooled at room temperature and cleaned with distilled water and acetone. After cleaning the samples were annealed from 500° C to 650 °C for 1 h so that the glass melting point can be maintained to prevent soda-lime glass. The annealed samples were taken for the investigation of structural and optical behaviour of the samples.

1.1 Ion exchange method:

In ion exchange method, the immersed glass with molten Ag and Na ions diffuse from the molten salts to the glass surface under thermal treatment. Ag ions embedded in glass matrix

from the Ag molten salt by replacing sodium ions (Fig. 1). The embedded Ag ions change the compositions of silicate glass by replacing the sodium ions are given in equation 1 in the manuscript.

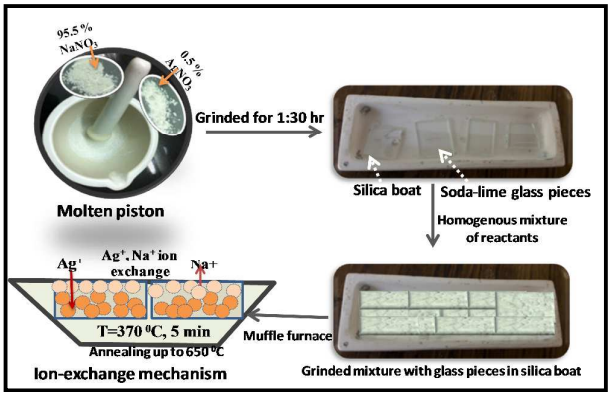

Figure S 1: schematic diagram of ion exchange mechanism for Ag embedded soda-lime glass

2. XPS spectra of ion-exchanged (Pristine) sample at 390 ºC

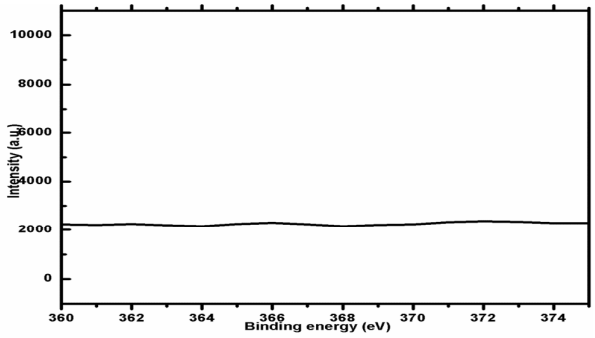

Figure S2. XPS spectra of the Ag embedded ion exchanged glass (pristine)

3. Equations: S 3

The Arhenius equation is given as-

$$k = Ae^{-E_a/(RT)} \quad (1)$$

Modified equation given as-

$$\log(abs) = \log A - \frac{E_a}{2.303R} \quad (2)$$

Thermodynamic parameters are expressed as-

$$\Delta S = \Delta H - \Delta G / T \quad (3)$$

Figure S3. Arhenius and thermodynamic equations for ΔH, ΔS, ΔG and E_a calculation

4. XRD analysis: **S4**

The particle size were calculated using Debye-Scherrer formula as give below-

$$D_p = 0.9\lambda / \beta \cos\theta$$

Where, D_p = Particle diameter size, β = FWHM (full width at half maximum), θ = diffraction angle, λ = wavelength of X-ray