NiO/Ag heterostructure: enhanced UV emission intensity, exchange interaction and photocatalytic activity

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With our starting reagents, the formation of NiO relies on two steps: (i) generation of $Ni(OH)_2$ sheet-like structure and (ii) conversion of $Ni(OH)_2$ sheets into NiO. During hydrothermal treatment at 90^0C $CO(NH_2)_2$ decomposes into NH_4^+ and OH^-. Then Ni^{2+}, present in the mixture solution, reacts with OH^- to form $Ni(OH)_2$. The reactions can be summarized as follows: [1, 2]

$CO(NH_2)_2 + H_2O \rightarrow 2NH_4^+ + CO_2 + OH^-$

$Ni^{2+} + 2OH^- \rightarrow Ni(OH)_2$

Thus produced $Ni(OH)_2$, crystallized in the hexagonal system with brucite-type structure after stacking of Ni(OH)2 layers along c-axis, can be divided into two polymorphs, α-phase and β-phase depending on the presence of ions or molecules between stacked layers. It has been established earlier that α-$Ni(OH)_2$ possesses brucite-type structures with oxygen atoms at the apexes of octahedrons those bridge three Ni^{+2}. XRD analyses (shown in Figure S1) of this phase reveals the formation of β- $Ni(OH)_2$. Strong covalent bond may be inferred to hole the atoms within layers those are stacked along c- axis according to its thermodynamic stability. In this context it may be stated that hexamethylenetetramine (HMTA, $CH_2)_6N_4$), a highly water soluble non-ionic tertiary amine derivative, are intercalated between two staking layers of $Ni(OH)_2$ to increase the distance between them. Upon heating produced layers of $Ni(OH)_2$ produces nanosheet of NiO.

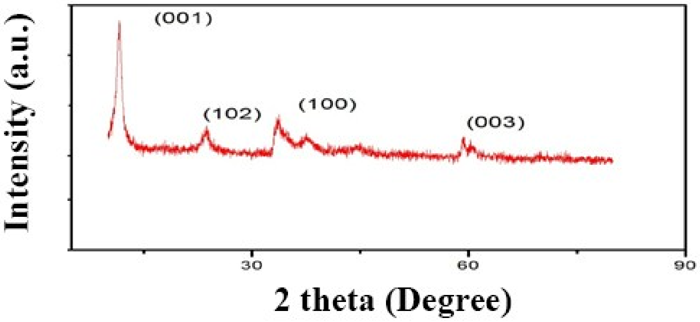

Figure S1: High magnification FESEM image of NFO.

As prepared NiO flake was used as template to grow Ag nanoparticles. We have measured negative potential (-1.82 mV) for the surface charge of this synthesized sample. Therefore, Ag^+ ion gets attached on the NiO flake due to electrostatic attraction where it would be reduced to give metallic Ag nanoparticle.

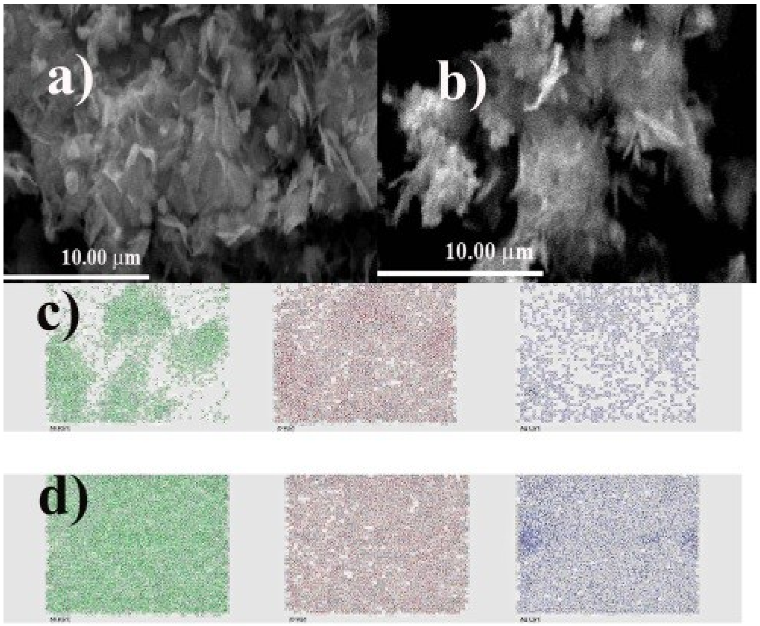

Figure S2 (a & b): SEM images of NAG1 and NAG2, (c & d): EDX mapping of that zone; oxygen (purple dots), nickel (green dots) and silver (blue dots).

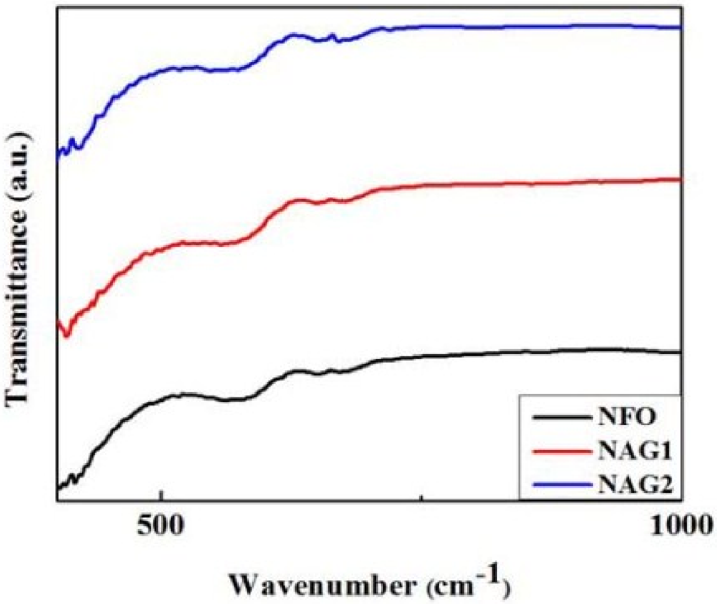

Figure S3: FTIR spectrum of the NFO, NAG1 and NAG2.

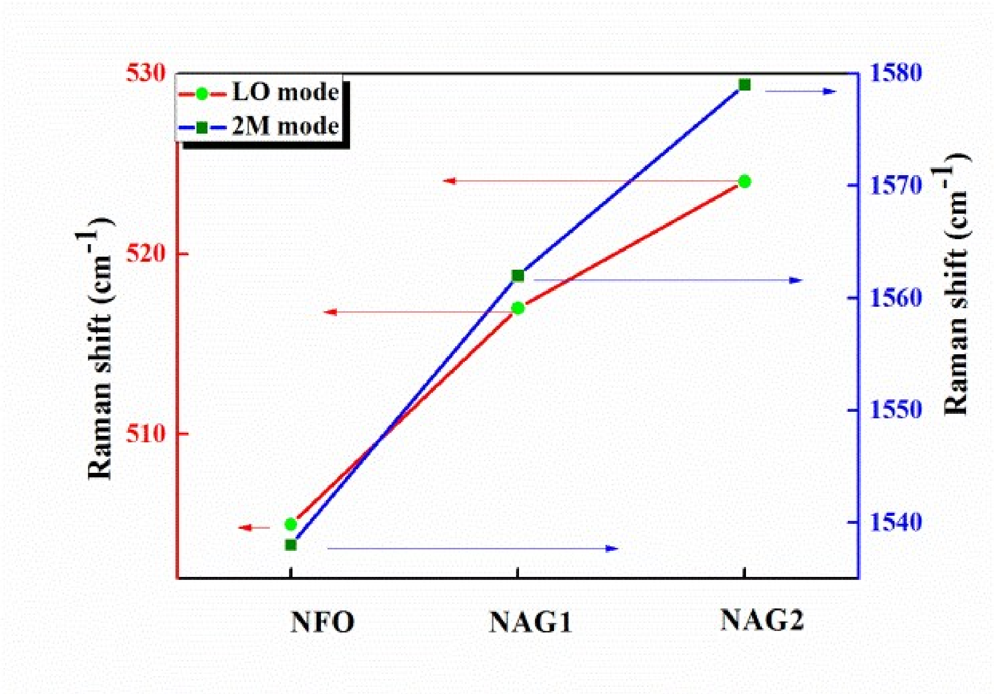

Figure S4: Variation of Raman shift LO phonon and 2M scattering mode for NFO, NAG1 and NAG2.

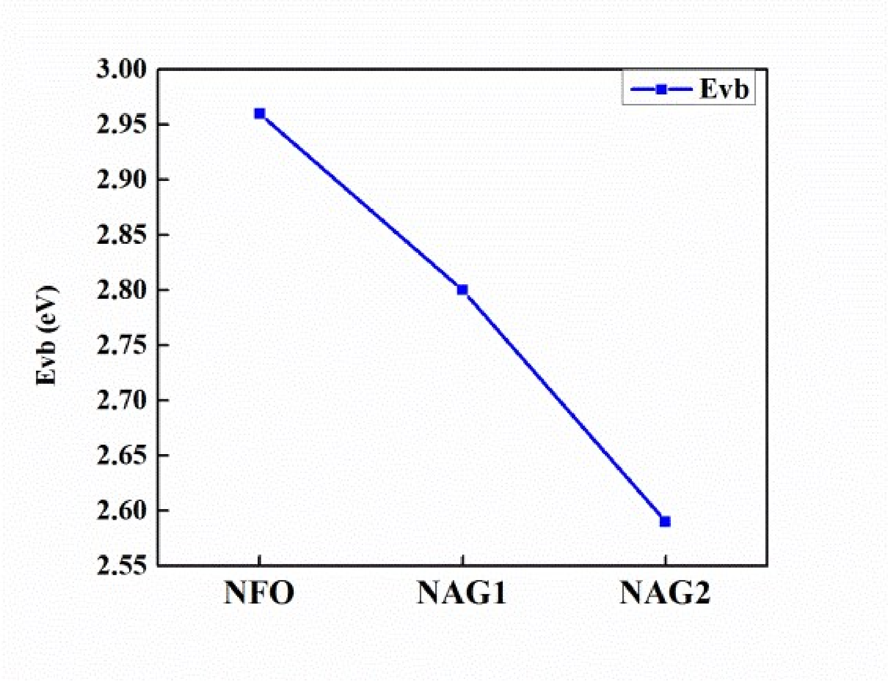

Figure S5: Valance band edge potential distribution.

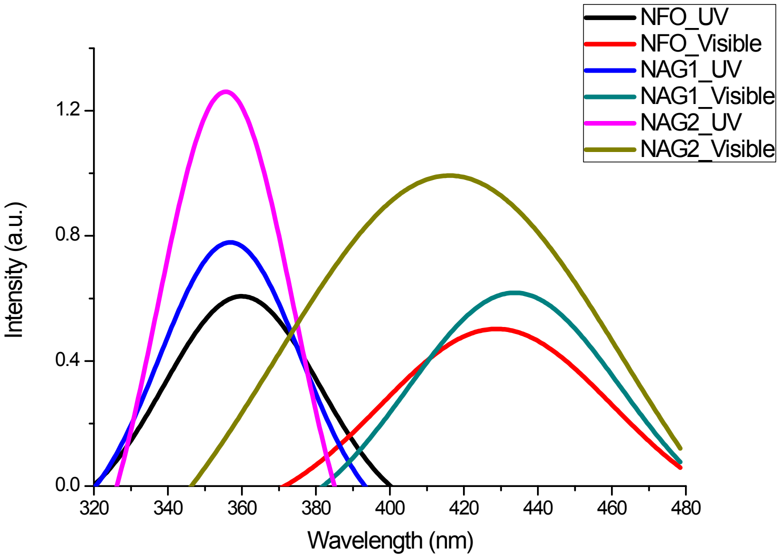

Figure S6: Photoluminescence spectra of the synthesized on same x-scale.

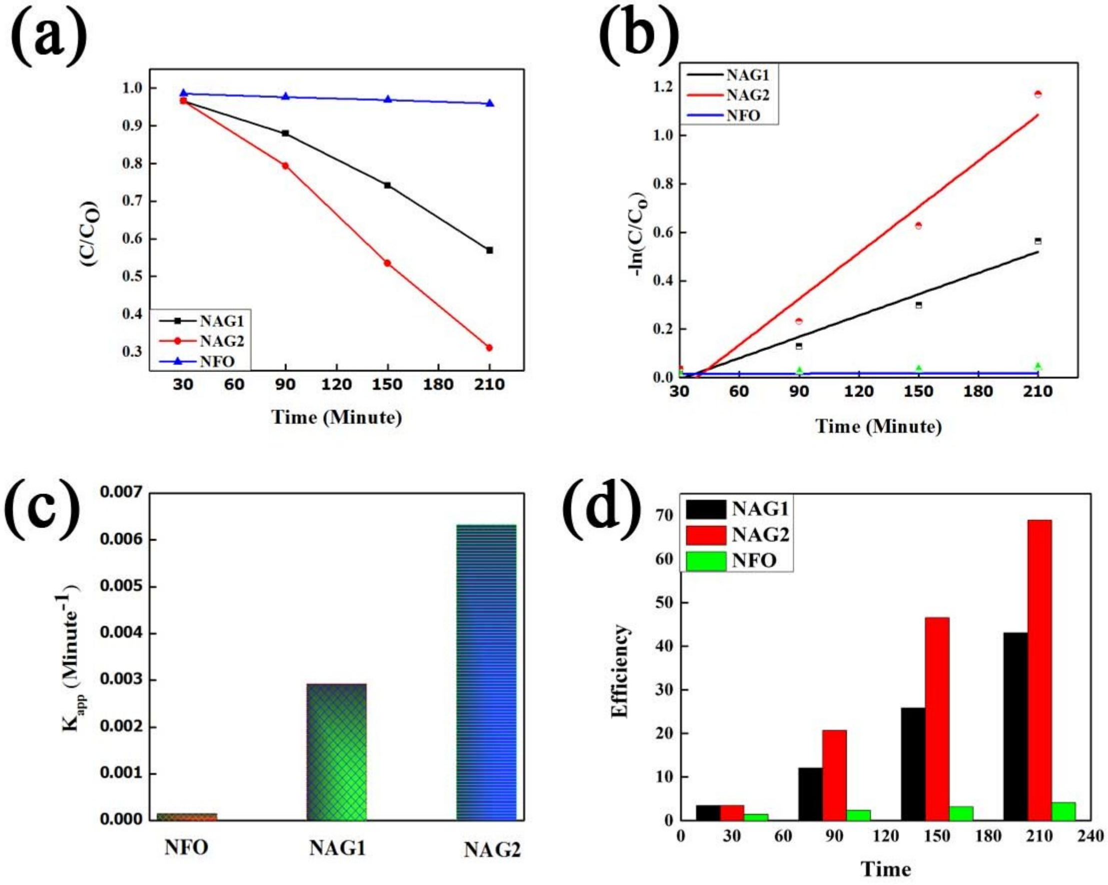

Figure S7 (a) and (b): C/Co and ln(C/Co) plot vs. t respectively (c): apparent rate constant for the different sample, and (d): efficiency of the different samples to different time

1. X. Li, S. Xiong, J. Li, J. Bai and Y. Qian, *Journal of Materials Chemistry*, 2012, **22**, 14276-14283.
2. S. K. Meher, P. Justin and G. R. Rao, *Nanoscale*, 2011, **3**, 683-692.