# Synthesis and characterisation of a new hetero-junction Ag/NiO Application to photochemical hydrogen production upon visible light.

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**1. Introduction** –The photochemical hydrogen production was actively investigated on semiconductor materials using the sun as energy source. Indeed, hydrogen is known to be a friendly energetic vector. It can be produced by many processes but many of them are expensive and require specific devices. In this kind of view, hetero-junctions materials have shown good efficiency for $H_2$ production [1, 2]. As a contribution in this field, this work is devoted to the preparation of a hetero-junction Ag/ NiO (5/95%), by nitrate route. The compound was characterized by physical and photo-electrochemical techniques and applied in photochemical hydrogen production upon visible light. The results were compared to that obtained with NiO, free of Ag additive.

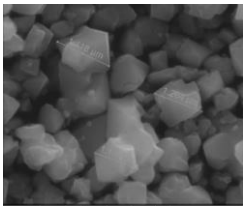

**Image 1.** SEM micrograph of the hetero-junction Ag-NiO.

**2. Experimental -** Nitrate route was used to synthesize the hetero-junction Ag/NiO (5/95 % wt.), at 350 °C. The phase was characterized using several physicochemical techniques including: X-ray diffraction, chemical analysis, scanning electron microscopy (SEM), BET surface area determination and study of the photoelectrochemical properties. The photocatalytic experiments were performed in a Pyrex reactor, connected to a thermostated bath (50 °C). The amount of evolved hydrogen was evaluated by volumetry in an experimental setup.

**3. Results and Discussion** - The SEM image of Ag/NiO (Image 1) exhibits homogeneous surface with regular grains whose size lies between 0.8 and 1.3 µm. The specific surface area of the hetero-junction as determined from BET measurement was characteristic of a low porosity. The optical gap of the sensitizer NiO was obtained by diffuse reflectance spectrum; a direct transition of 1.51 eV was observed.
The electrical conductivity measured on sintered pellet follows an exponential type law with activation energy of 0.12 eV. Depositing Ag onto NiO has improved the rate of $H_2$ evolution. Indeed, we observed that the amount of $H_2$ obtained over the hetero-junction is twofold (160 µmol), compared to NiO alone. This result highlighted the role of Ag. A mechanism of the electrochemical process of the hetero-junction Ag/NiO (5/95 % wt.) is proposed. The photocatalytic process is well clarified in the energy diagram.

**4. Conclusions -** The hetero-junction Ag/NiO (5/95 % wt.) was prepared by nitrate route. The physical and electrochemical characterizations showed a well crystallized compound, with *n* type conduction. An energy diagram was built which predicted the electrons transfer from NiO to $H_2O$ via Ag clusters. The hetero-junction is efficient for $H_2$ production and shows the best performance as compared to NiO alone.

**5. References**

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[2] R. Bagtache, F. Saib, K. Abdmeziem, M. Trari, International Journal of hydrogen Energy xxx (xxxx) xxx