Enhanced Sensing Performance of ZnO nanostructures Synthesis by Hydrothermal and Laser Ablation Methods

by

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Aim of this work

The aim of this work involves synthesis Preparation ZnO NPs from (Zn) metal by pulsed laser ablation (PLAL) and hydrothermal method. deposition on the porous silicon, investigate the characteristic of Zinc oxide films after added to porous silicon substrate at different laser energy and different etching time, which it has unique properties that can be used for enhancement photodetectors performance and sensors applications.

Nanoparticles (NPs): are defined as particle that have the size at the range 1-100 nm, because of it's smaller size may be exploited for their novel electronic and optical properties, which differ from those of the corresponding bulk materials.

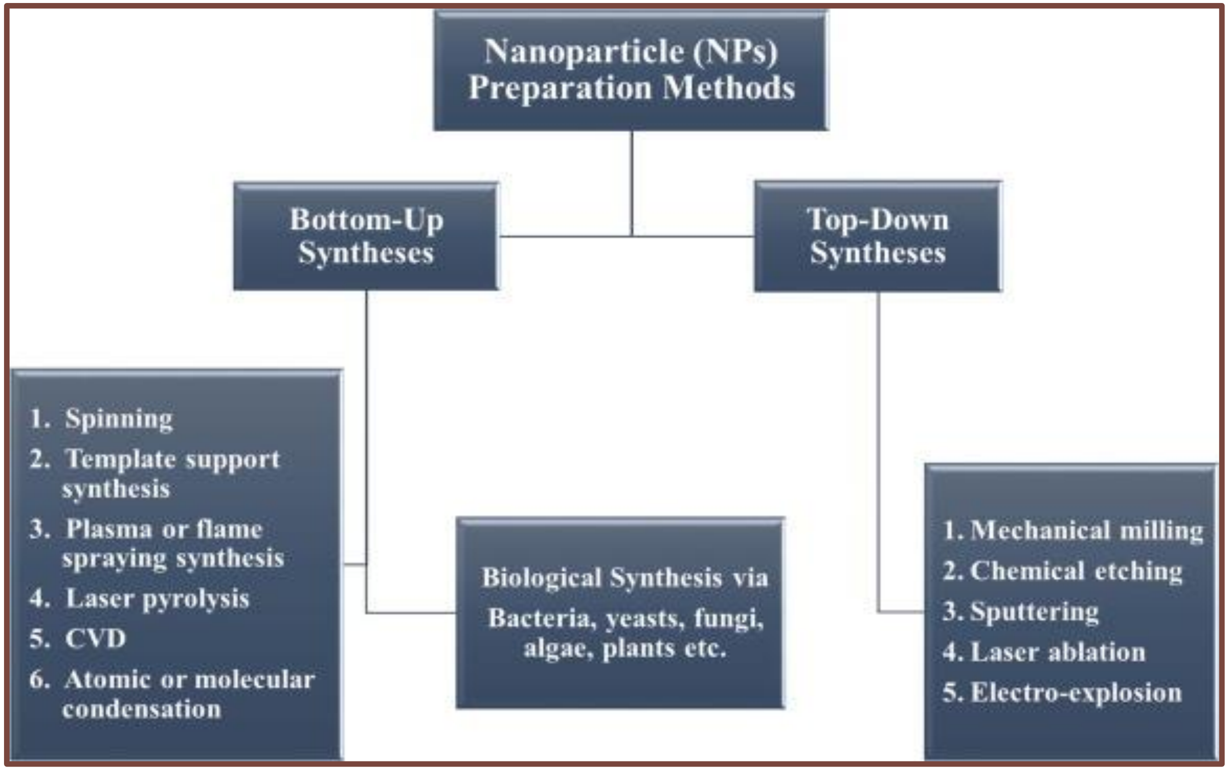

Fig. (1): Nanoparticle(NPs) preparation Methods

Zinc Oxid nanoparticles (ZnO NPs)

Zinc oxide nanoparticles are nanoparticles of zinc oxide that have diameters less than 100 nanometers.

They have a large surface area relative to their size and high catalytic activity.

The exact physical and chemical properties of ZnO NPs depend on the different ways they are synthesized. Some possible ways to produce ZnO NPs are ***laser ablation***, ***hydrothermal*** methods, ***electrochemical depositions***, ***sol–gel*** method, ***chemical vapor deposition***.

Laser Ablation: The term laser ablation refers to ablated of material during interaction of laser radiation with mater.

Pulse laser ablation in liquid: is a physical approach used to produce nanoparticle, the laser energy will be absorbed by target and leads to vaporize it then condense as nanoparticle.

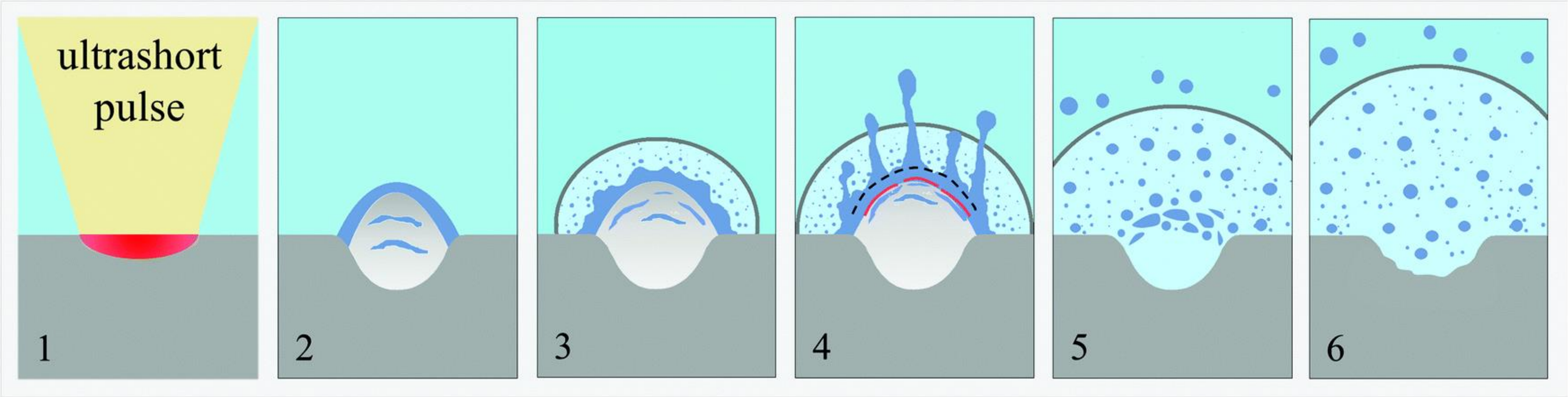

Fig. (2):Diagram of mechanism laser ablation process in liquid

Hydrothermal method: is one of the most commonly used methods for preparation of nanomaterials. In hydrothermal synthesis, the formation of nanomaterials can happen in a wide temperature range from room temperature to very high temperatures.

Figure (3) : Teflon lined autoclave.

Porous silicon (PS): can be defined as a silicon crystal having a network of void form when c-Si wafer is etched electrochemical in HF-hydrofluoric acid based solution etching.

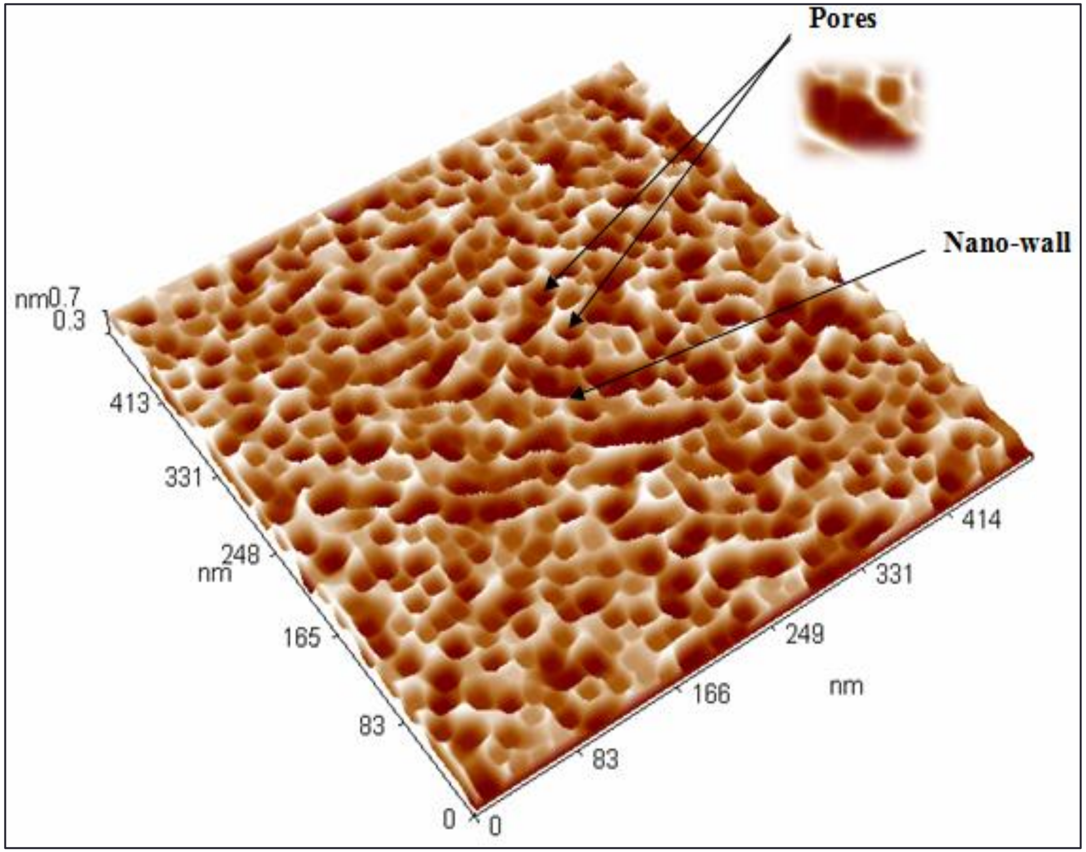

Fig. (4): AFM image for porous silicon

Classification of porous Silicon

Type of material	Dominant pore width (nm)
Microporous	≤ 2
Mesoporous	2-50
Macroporous	> 50

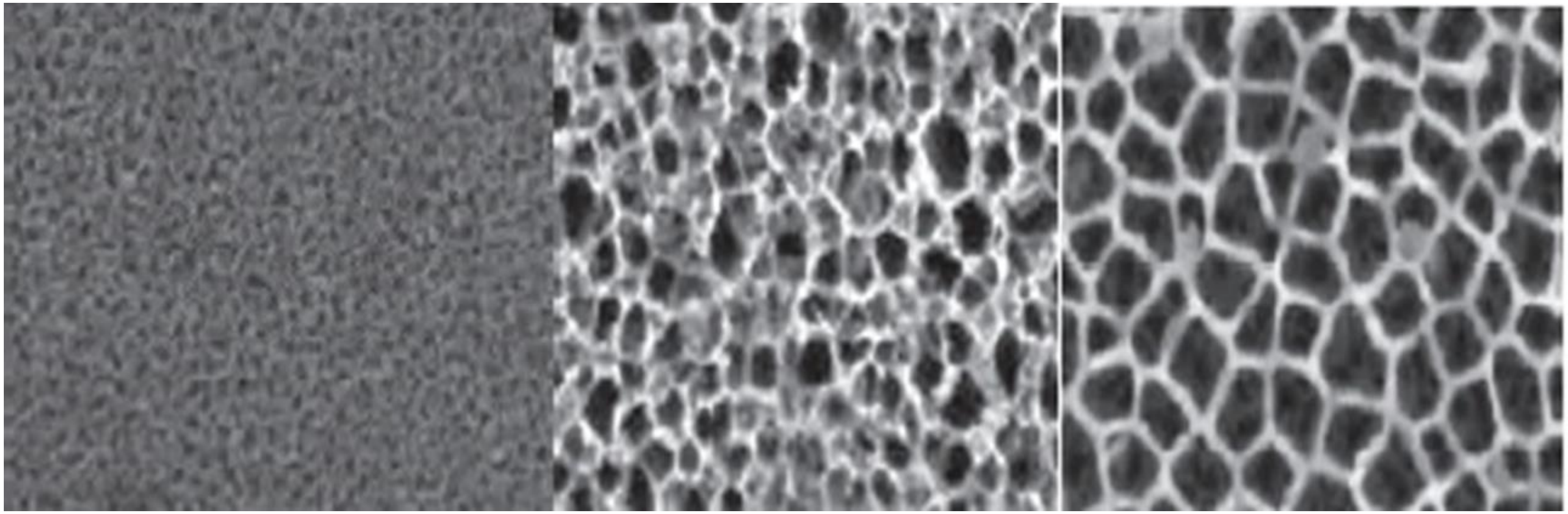

Fig. (5): PS structures: microporous (left), mesoporous (center) and macroporous (right)

Basic Processes For Formation of the PS

1. ElectroChemical Etching (ECE)
2. PhotoChemical Etching (PCE)
3. Photo-ElectroChemical Etching (PECE)
4. Stain Etching (SE)

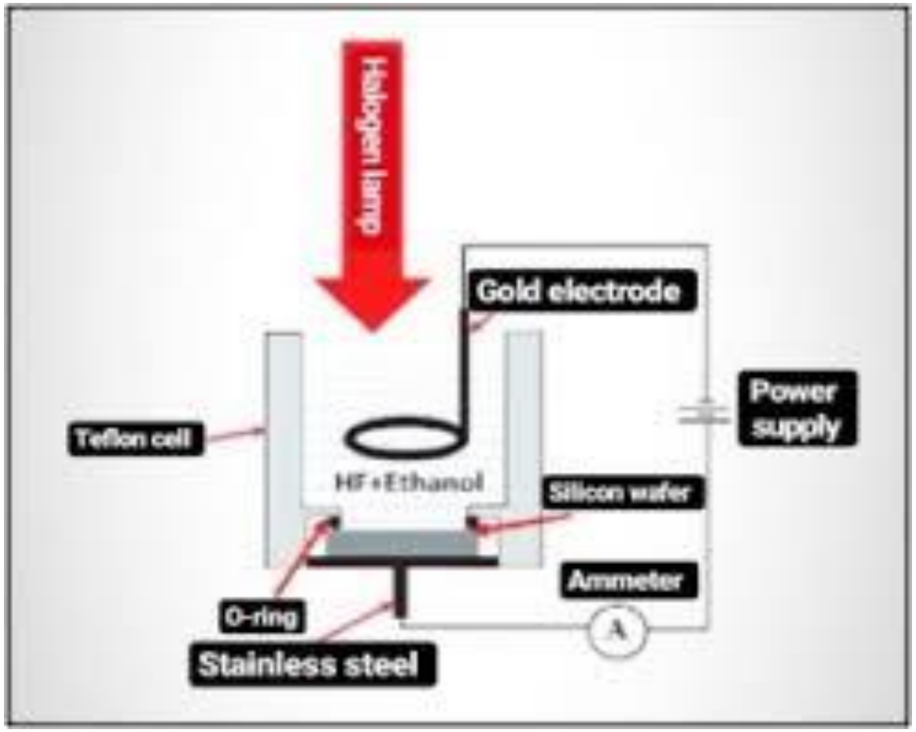

Figure.(6): Schematic diagram of the Photo-electrochemical etching

Why using Porous silicon as substrate for ZnO?

Porous silicon is a sponge-like open structure and has large specific surface area and this make PS nanostructures a suitable material for accommodating ZnO into its pores and thus establishing a good nucleation site which is essential for the growth along the preferred orientation .

Thank you