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Micromotors driven by UV light based on advanced hybrid GaN/ZnO nanoarchitectured microtubes

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Aim:

It consists in the development of a new system based on micrometric-scale objects capable to move through liquid media in a controlled manner.

Solution:

Synthesis of GaN/ZnO-based microtubes with nanometer-scale thin walls, which are functionalised with Au nandots on the inner surface of the walls and show intense photocatalytic reactions under UV light excitation.

Advantages:

- ☒Simple and innovative concept of micromotors;
- ☒New hybrid nanostructured GaN/ZnO microtubes with outer hydrophobic surface and inner hydrophilic surface of chemically stabilized ZnO;
- ☒Chemically stable nanomaterial;
- ☒Size dependent speed of the micro-engine;
- ☒Remote control of movement using UV light;
- ☒Possibility to integrate in microfluidic devices and advance the field of microfluidics.

Description:

Functional microstructures with designed hierarchical and complex morphologies and large free active surfaces based on novel hybrid nanoarchitectured GaN/ZnO microtubes with an outer hydrophobic GaN surface and an inner hydrophilic surface of chemically stabilized ZnO functionalized with Au nanodots have been developed and characterized (Fig. 1). The presence of an epitaxially stabilized and chemically extremely stable ultrathin layer of ZnO on the inner wall of the produced GaN microtubes is evidenced. As a proof of concept (Fig. 2), the produced microtubes are used as photocatalytic micromotors in the presence of hydrogen peroxide solution with luminescent properties, which are appealing for future environmental applications and active matter fundamental studies. Our experiments show intense photocatalytic reactions under UV light excitation in the presence of hydrogen peroxide exclusively for microtubes functionalized with gold nanodots. The developed micromotors are promising for sensing applications, e.g., by monitoring the fluorescence quenching in the presence of a certain analyte, or environmental cleaning by the degradation of organic pollutants by photocatalytic reactions [1, 2].

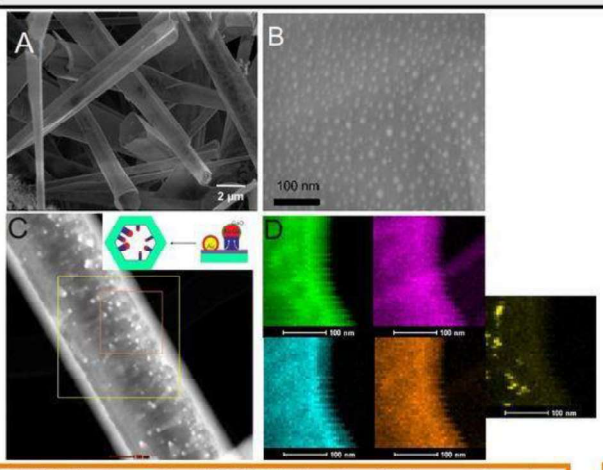

Fig. 1. (A) SEM micrographs of GaN/ZnO microtubes. (B) Au nanodots on the inner side of the microtube walls. (C) TEM visualization of the microtube with Au nanodots grown on the nanowires inside the microtubes with the chemical composition mapping showed in (D)

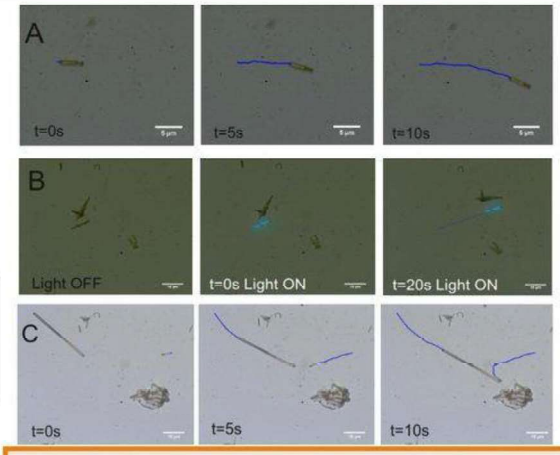

Fig. 2. Optical images and corresponding tracking of microtubes with different sizes: (A)=5µm, (B)=10µm, (C)=30µm. Motion under UV illumination at different time points

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