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NATIONAL INSTITUTE OF INVENTICS, IASI, ROMANIA

National Center for Materials Study and Testing,
TECHNICAL UNIVERSITY OF MOLDOVA

COST-EFFECTIVE FABRICATION OF HYBRID Ga_2O_3/GOLD NANOSTRUCTURES FOR ADVANCED SENSING AND CATALYSIS APPLICATIONS

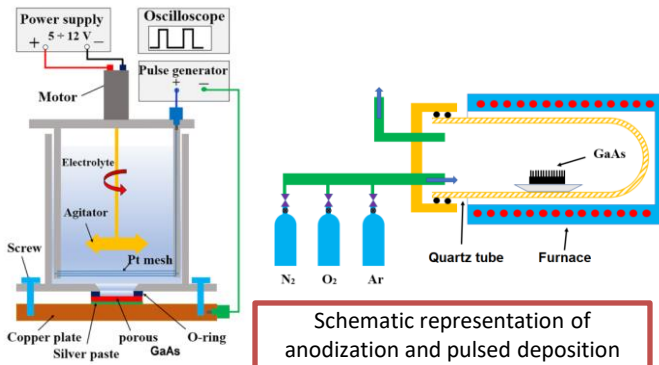
Research project #020402 - ETISEL "Development of technologies and investigation of the properties of layered semiconductor compounds, hybrid nanostructures and laser sources".

Inventatori/Inventors: Elena MONAICO, Eduard MONAICO, Veaceslav URSAKI, Ion TIGINYANU

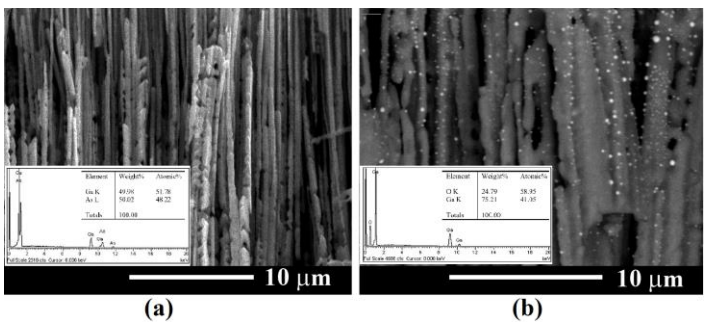
Description: A three-step process has been developed for the fabrication of hybrid nanostructures consisting of Ga_2O_3 nanowires array decorated with gold nanodots, addressing the issue of noble metal functionalization of oxide nanowire networks with high resistance. The first step involves anodizing GaAs substrates to produce GaAs nanowires with high electrical conductivity. In the second step, gold nanodots are electrochemically deposited. The third step involves thermal treatment in an argon atmosphere with a small amount of oxygen, selectively converting GaAs nanowires into Ga_2O_3 nanowires covered with gold nanodots. The process is cost-efficient and accessible, and the resulting hybrid nanostructures exhibit promising properties for various applications in sensing, photodetection, and catalysis.

Advantages:

- **Cost-effectiveness**: electrochemical methods minimize material and equipment costs, making it an economically viable option for nanostructure synthesis.
- **Controlled fabrication**: precise control over nanostructure dimensions, crystallographic orientation, and diameter modulation, providing a versatile toolkit for tailored engineering by design.
- **Enhanced properties**: the resulting hybrid nanostructures exhibit enhanced properties suitable for various applications, including sensing, photodetection, and catalysis, opening up new avenues for advanced materials science and technology.
- **Selective conversion**: The selective thermal treatment step ensures the transformation of GaAs nanowires into Ga_2O_3 nanowires while maintaining the gold nanodots' presence, preserving desired structural features and functionalities.



Schematic representation of anodization and pulsed deposition setup as well as thermal annealing.



SEM image and EDX results analysis of the transformation of GaAs nanowires with Au nanodots in Ga2O3 nanowires via thermal treatment.

References: **(1)** ***Beilstein J. Nanotechnol.*** **2020**, 11, 966–975. https://doi.org/10.3762/bjnano.11.81; **(2)** ***Semicond. Sci. Technol.*** **2020**, 35, 103001, https://doi.org/10.1088/1361-6641/ab9477; **(3)** ***Coatings*** **2022**, 12, 1521, https://doi.org/10.3390/coatings12101521; **(4)** ***Physica status solidi (RRL) – Rapid Research Letters*** **2023**, 2300039, https://doi.org/10.1002/pssr.202300039.

UNIVERSITATEA TEHNICĂ A MOLDOVEI
National Center for Materials Study and Testing
Tel: (373 22) 50-99-20, e-mail: eduard.monaico@cnstm.utm.md www.ncmst.utm.md