Journal of Nanosciences: Current Research
ISSN 2572-0813
2020
Vol.5 No.5

Tuning the morphology of cupric oxide structures: From flakes to slender-wires

Rupali Nagar and Abha Mahajan

Symbiosis International (Deemed University), India

Abstract

In this work, the growth of cupric oxide (CuO), a p-type semiconductor with narrow band gap range (1.3 to 2.1 eV) is studied. CuO is a diverse material with its uses ranging from solar cells, heterogeneous catalysis, field emission devices, lithium-ion electrodes, sensing devices, cathode catalyst in fuel cells, etc. Here, copper sulphate pentahydrate ($CuSO_4{\cdot}5H_2O$), sodium hydroxide (NaOH) and polyethylene glycol 2000 (PEG) have been used as-received. Appropriate amounts of precursors were stirred magnetically and reduced using NaOH. Thereafter, the samples were filtered, washed, and dried. Various morphologies ranging from flakes to slender wires were obtained as shown in Figure 1. The flaky microstructure is attributed to presence of PEG that acts as a stabilizer, dispersant while mild heat treatment (60-80 °C) of precursors leads to slender wire morphology. The ratio of copper precursor (CP) and PEG solutions influences the morphology. While molarity ratio of CP:PEG=1 yields flaky feather-like morphology, CP:PEG=50 results in stacked flakes. When PEG is present in abundance, it maintains layered morphology of copper hydroxide, an intermediate product, and its strong steric repulsion inhibits stacking of hydroxide morphology. Upon heating, the hydroxide reduces to flaky CuO structures. For low PEG concentrations, the Cu nuclei first agglomerate. On simultaneous heat treatment, PEG degrades, mechanical strength of polymer network wanes leading to stacked growth. Further, if NaOH is added in one shot along with heating, slender wire morphology is obtained. The combined effects of lower PEG concentration and temperature lead to weaker steric repulsion and mechanical strength of polymer chain resulting in slender morphology of CuO wires. All the morphologies support a high surface area and can serve as potential sensors due to availability of large number of adsorption sites. The reported technique has very simple implementation, is cost-effective and yet yields diverse CuO morphologies with promising sensing capabilities.

Biography:

Rupali Nagar is working at Symbiosis Institute of Technology (SIT), Pune, India as an Assistant Professor in the Department of Applied Science and is the Group Leader of Nanomaterials for Energy Applications Lab at SIT. She completed her Ph.D. from Indian Institute of Technology Delhi (IIT D) and continued her research while working at Indian Institute of Technology Madras (IIT M) as Project Officer till 2012. Her research interests include studying nanomaterials for energy and gas sensing applications.

Speaker Publications:

1. Nagar R, Varrla E, Vinayan BP. (2018) Chapter 10 – Photocatalysts for hydrogen generation and organic contaminants degradation – Multifunctional Photocatalytic Materials for Energy Applications, Woodhead Publishing in Materials, p. 215-236.
2. Nagar R, Vinayan BP. (2017) Chapter 5 - Metal-semiconductor core–shell nanomaterials for energy applications A2 - Gupta, Raju Kumar, in Metal Semiconductor Core-Shell Nanostructures for Energy and Environmental Applications, M. Misra, Editor. 2017, Elsevier. p. 99-132.
3. Vinayan B. P., Nagar R., Ramaprabhu S. (2016) Investigating the role of carbon support in catalytic activity of bimetallic Pt-Au nanoparticles for PEMFC application. Materials Research Express, 3: 095017-1-12.
4. Vinayan B. P., Nagar R., Ramaprabhu S (2013). Solar light assisted green synthesis of palladium nanoparticle decorated nitrogen doped graphene for hydrogen storage application. Journal of Materials Chemistry A 1:11192-99.

21st World Congress on Materials Science and Engineering; Webinar - June 22-23, 2020.

Abstract Citation:

Rupali Nagar, Tuning the morphology of cupric oxide structures: From flakes to slender-wires, Advanced Materials - 2020, 25th International Conference on Advanced Materials & Nanotechnology; Webinar - November 23-24, 2020

(https://europe.materialsconferences.com/abstract/2020/tuning-the-morphology-of-cupric-oxide-structures-from-flakes-to-slender-wires)