CuO-Fe_2O_3 nanoheterojunctions for photoelectrochemical energy conversion

A.Szkudlarek[1], K. Mech[1], A.Kmita[1], A.Maximenko[2], M. Sikora[1]

[1] *AGH University of Krakow, Academic Centre for Materials and Nanotechnology, av. Mickiewicza 30, 30-059 Krakow, Poland*

[2] *Solaris National Synchrotron Radiation Centre, Jagiellonian University, Czerwone Maki 98, 30-392 Krakow, Poland*

aleszkud@agh.edu.pl

In this work, we present the studies of hybrid CuO-Fe_2O_3 nanoparticles, which can be used to convert the visible light to chemical energy without external bias [1]. The materials have been selected due to their peculiar electronic properties e.g. the values of optical band gap in the visible light range and type of conductivity - 1.58 eV for CuO (p-type) and 2.15 eV for Fe_2O_3 (n-type). Such materials absorb light in visible range. The structure of the junction is responsible for the electric field formation, which effectively limits charge transfer recombination. Subsequently, those carriers can be involved in the chemical reactions: oxidation of water on the copper oxide side or reduction of oxygen or iron on the iron oxide side.

The morphology and the crystal phase of nanoparticles were studied using Transmission Electron Microscopy, X-ray Absorption using synchrotron radiation; the optical band gaps were determined from the reflectance measurements using Kubelka-Munk model, the position of the flat band potential was based on the Mott-Schottky dependence.

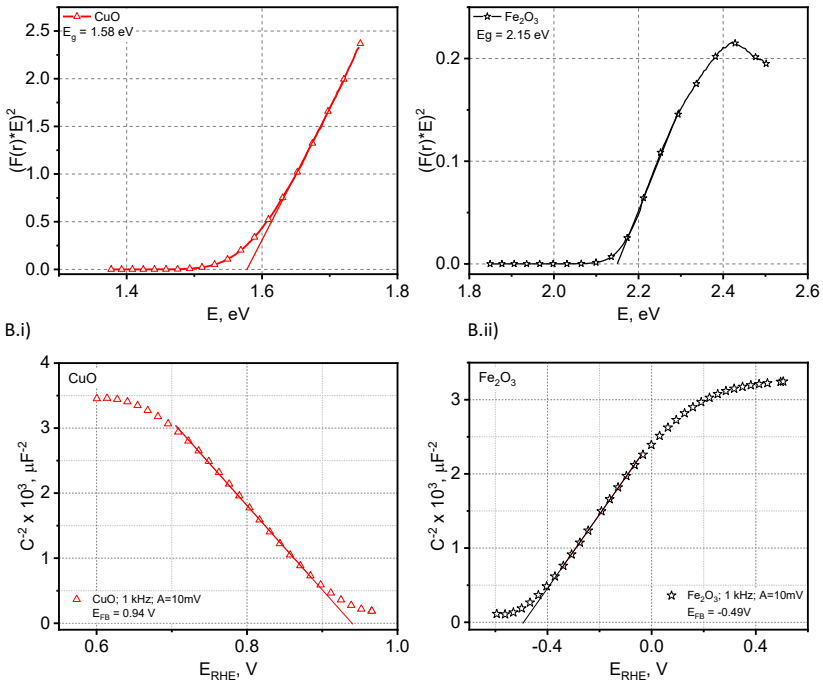

Fig. 1. A) Tauc's plots B) and Mott-Schottky plots for i) CuO and ii) Fe_2O_3

[1] Ying Gao, Nan Zhang, Chunru Wang, Feng Zhao, and Ying Yu, ACS Appl. Energy Mater., 3, 1, 666–674, (2020) https://doi.org/10.1021/acsaem.9b01866