

STRUCTURE AND PROPERTIES OF MATERIALS FROM BiOX (X=Br, Cl, I, BrO₃), WITH APPLICATION FOR PHOTOCATALYTIC WATER PURIFICATION AND NO₂ GAS SENSORS

I.G. Genov¹, A.G. Bannov², S.A. Shpakova², E.V. Lukin¹, S.E. Kichanov¹, I.I. Vinogradov¹,
N.A. Drozhzhin¹ and D.P. Kozlenko¹

¹ *Joint Institute for Nuclear Research, Dubna, Russia*

² *Novosibirsk State Technical University, Novosibirsk, Russia*

E-mail: genov@jinr.ru

The emergence of novel environmental protection technologies based on the application of semiconductor photocatalytic materials for converting CO₂, splitting water to generate H₂, and eliminating pollutants, has stimulated extensive research in the field of photocatalytic chemistry. In addition the accurate detection of human hazardous gases, such as NO₂, using a low-cost gas sensing device is quite important.

The semiconductor photocatalysators can be used to treat degrading toxic organic pollutants in wastewater contaminated with dyes and antibiotics. They converting pollutants into simpler or non-toxic molecules, without the need for additional treatments using expensive oxidizing chemicals.

The materials containing bismuth show improved spontaneous polarization effects due to the stereochemical activity of the 6s² lone pair of Bi³⁺ ions. The bismuth-based layered materials, present extended photooxidative ability in the splitting of various pollutants. The layered crystal structures provide the formation of an internal electric field through the diffusion of charges between the layers and the easier separation of electron-hole pairs.

The layered photocatalytic materials with the general formula BiOX (X = Cl, Br, I or BrO₃) and a silenite structure, has unique structural and physical properties, and a complex band structure. They exhibit an open layered structure with -Bi₂O₂- sheets inserted into double halogen atomic units. A stack of [X-Bi-O-O-Bi-X] layers is formed with weak Van-der-Waals interactions between each layer [1]. Moreover these materials has not been studied much in the realm of gas detection, especially NO₂ [2].

In our study were successfully synthesized Bi-based layered materials for use for photocatalysts and gas-sensing sensors, via a solution combustion method using Bi(NO₃)₃·5H₂O as the starting material .

The phase and crystal structures analysis of the obtained samples were performed using powder X-ray (XRD) and neutron diffraction (ND). The XRD and ND data were analyzed using the FULLPROF package. The structural and morphologies of prepared samples were analyzed by scanning electron microscopy (SEM).

- [1] X.Dong, Y. Zhang, Z.Zhao (2021) Role of the Polar Electric Field in Bismuth Oxyhalides for Photocatalytic Water Splitting, *Inorg. Chem.* 60 8461-8474.
- [2] N.Dhariwal, P.Yadav, A.Sanger, S.B.Kang, M.S.Goyat, Y.K.Mishra, V.Kumar((2005). Fabrication of a room-temperature NO₂ gas sensor with high performance at the ppb level using an rGO/BiOCl heterostructure. *Mater. Adv.* 5, 4187-4199 .