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Mixed-anion visible-light-active photocatalysts for green energy conversion and environmental remediation

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Abstract:

As a replica of natural photosynthesis, semiconductor-based artificial photosynthetic system is regarded as one of the most economically viable and green chemical processes to produce renewable hydrogen energy from solar water splitting and to remove organic pollutants. To efficiently utilize solar energy in the wide visible range, it is necessary to enhance the visible-light-driven photocatalytic performance of the known photocatalysts and to discover novel visible-light-active photocatalysts. We have successfully developed an NH_3-assisted direct flux growth approach to reduce the density of intrinsic defects in transition metal oxynitrides ($BaTaO_2N$, $BaNbO_2N$, $LaTiO_2N$, etc.), which led to the substantial enhancement in solar water splitting activity. New Dion-Jacobson phase $CsBa_2Ta_3O_{10}$ was discovered, and two-dimensional oxynitride nanostructures with high crystallinity, less defect density, and high photocatalytic activity of $CsBa_2Ta_3O_{10}$, $KLaTiO_4$, and $K_2La_2Ti_3O_{10}$ were synthesized. Our work revealed new insights into why creating a *p-n* heterojunction using bismuth oxyhalides (BiOCl, BiOI) and doping are important for bandgap engineering and enhancing the photocatalytic activity of less active photocatalysts. As an emerging class of inorganic materials, mixed-anion compounds have potential applications in green energy conversion and environmental remediation.

Dr. Mirabbos Hojamberdiev was born on the 3rd December 1977 and received his Ph.D. degree from Tashkent Institute of Chemical Technology, Uzbekistan in 2005. Dr. Hojamberdiev is a Senior Researcher at Turin Polytechnic University in Tashkent, Uzbekistan. His research aims at exploring new crystal phases and studying the impacts of crystal facet, morphology, dimension, and size of oxide and non-oxide crystals on photocatalytic and photoelectrochemical water splitting activity for hydrogen evolution and photocatalytic removal of various organic pollutants from contaminated water and air. He received The World Academy of Sciences (TWAS) Prize for Young Scientists in 2010, Atta-ur-Rahman Prize in Chemistry for Young Scientist in 2015, Elsevier Foundation - TWAS Sustainability Visiting Expert Award in 2017, and Georg Forster Research Award in 2017.