Novel Photocatalysts for Oxidation and Reduction of Water under Visible Light: Substitution Effect of Lead in Perovskite-Related Layered Oxides

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The photocatalytic water splitting using sunlight is one of the most promising methods to store solar energy as chemical energy. In search of new highly efficient photocatalysts for water splitting under visible light irradiation, we studied the lead substitution effect in perovskite related layered niobates and titanates in a systematic manner. Our strategy was to shift the photocatalytic activity from UV into the visible light range, by high or complete substitution of cations in UV-active perovskite material with lead ion. We investigated layered perovskite phases of the Aurivillius $(Bi_2O_2)^{2+}(A_{n-1}B_nO_{3n+1})^{2-}$, Dion-Jacobson $M[A_{n-1}B_nO_{3n+1}]$ and Ruddlesden-Popper $(A_{n+1}B_nO_{3n+1})$ types. We found in all the three structure type examples, that a non-visible light absorbing, non-photocatalytically active lead-free phase can be converted by lead substitution, into a visible light absorbing, visible light photocatalytically active phase. In this communication we report on the importance of lead substituion in obtaining visibly active layered photocatalysts.