PHOTOCATALYTIC PROPERTIES OF SOLID SOLUTIONS BASED ON $Bi_2FE_4O_9$

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The discovery of the properties of a multiferroic in $Bi_2Fe_4O_9$ has led to an increase in the number of studies of materials based on this ferrite. The aim of this work was to synthesize $Bi_{1.9}La_{0.1}Fe_4O_9$ solid solution and to study its photocatalytic properties. According to X-ray phase analysis, the substitution of 10 mol % Bi^{3+} ions by La^{3+} ions in $Bi_2Fe_4O_9$ leads to the formation of the corresponding solid solution. This fact is confirmed by a slight change in the crystal lattice parameters of the orthorhombically distorted mullite structure. The photocatalytic activity of the $Bi_{1,9}La_{0,1}Fe_4O_9$ powder was studied at the room temperature by the degradation of the Acid Telon Blue dye (ATB) in an aqueous solution, under continuous stirring and exposure in the ultraviolet (UV) radiation. 100 ml of aqueous solution (in deionized water) was prepared by completely dissolving 1.0 mg of ATB dye and then dispersing 0.010, 0.020, 0.030 or 0.040 g/L of $Bi_{1,9}La_{0,1}Fe_4O_9$ powder. The ATB solution without $Bi_{1,9}La_{0,1}Fe_4O_9$ show small changes under UV-light irradiation up to 17.6 % efficiency after 90 min. The presence of 100 – 400 mg/L of $Bi_{1,9}La_{0,1}Fe_4O_9$ shows the best activity (about 37.4 %).

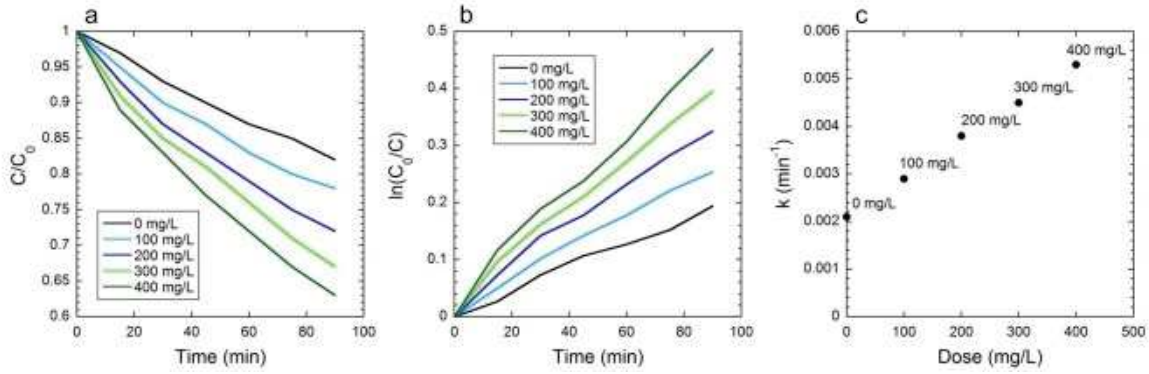

Figure 1. Residual ATB dye concentration as a function of UV radiation exposure time **(a)**, typical plots for determining the *k* **(b)** and the *k* obtained for the different content of $Bi_{1,9}La_{0,1}Fe_4O_9$ **(c)**.

We described the kinetics of the ATB decomposition reaction by the formal pseudo-first-order model as expressed in **[1]:** $\ln(C_0/C) = kt$, where t – irradiation time, k – reaction rate constant, C_0 – initial concentration, and C – current concentration of the ATB dye for the t. The plots (**Figure 1**) of $\ln(C_0/C)$ versus t exhibit approximately straight lines for the various doses showing the apparent first-order rate constants (**Figure 1b**). The k increases with increasing content of $Bi_{1.9}La_{0.1}Fe_4O_9$. The reaction rate constant k were 0.0053, 0.0045, 0,0038 and 0.0029 min^{-1} for the 400, 300, 200 and 100 mg/L respectively (**Figure 1c**). The reaction rate constant k without $Bi_{1.9}La_{0.1}Fe_4O_9$ was 0.0021 min^{-1}.

References

[1] K. V. Baiju, S. Shukla, K. S. Sandhya, *et al*. J. Phys. Chem. C, 2007, 111, 7612-7622.