Structural analysis of sunlight efficient Cu and Zr modified TiO_2 photocatalyst

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Solving of the renewable energy as well as environmental sustainability issues is on the top of consideration nowadays. Using abundant, inexpensive, nontoxic and efficient material, photocatalysis can be a great alternative and promising approach for many important processes [1]. The most known (due to its availability and appropriate properties) photocatalyst is TiO_2. However, it is only activated by irradiation at wavelengths shorter than 400 nm. To effectively utilize light with longer wavelength (visible spectrum) metal and non-metal doping were explored [2]. Nevertheless, quantum yield of electronic process under visible light in doped materials is much lower than under UV, due to crystal defects and generation of recombination centers. On the other hand the surface modification process is very attractive because the visible-light activity can be induced without changes in crystal structure. Most probably, visible light sensitivity can be achieved by the interfacial charge transfer process of excited TiO_2 electrons to the modifier [3].
Evonik Degussa P25 is one of the most efficient photocatalyst, showing photocatalytic activity even under the visible light [4]. The surface modification of TiO_2 with two different elements simultaneously finds its place among different approaches. The improvement in the activity of TiO_2 modified with appropriate combination of two or more elements is assigned to the existence of synergistic effect. The promising combination for sunlight driven TiO_2 photocatalysis is a combination of Cu and Zr for TiO_2 surface modification [5].
The objective of our research is to improve photocatalytic properties of P25 by facile surface modification method with Cu and Zr, to find the correlation between catalytic and structural properties of modified P25 materials, and to identify the synergistic role of the two elements. We report on the results of Cu and Zr K-edge EXAFS (Extended X-ray Absorption Fine Structure) analysis of Cu and Zr chemical state and local environment in the surface modified P25 photocatalyst.

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