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EVALUATION

PhD dissertation by Abdul Wafi

titled

"Preparation and characterization of nitrogen-doped TiO_2 semiconductors for photocatalytic degradations"

The dissertation presents original research results in the field of photocatalysis. The focus is on the preparation of N-doped TiO_2 by use of different methods and different starting materials. Heterogeneous photocatalysis is regarded as a useful tool in degradation of organic pollutants or harmful bacteria because almost complete mineralization can be achieved without secondary pollution at room temperature and pressure. Although TiO_2 photocatalyst has been investigated and utilized for decades its band gap is rather wide, therefore it can utilize only a small part of the sunlight's energy. However, there is an increasing demand for extending the sensitivity of this catalyst towards the visible-light region. Doping of TiO_2 with metal and non-metal elements is a useful tool for this purpose. Consequently, the topic has both theoretical and practical importance.

The amount of the work is sufficient; the results are interesting. The dissertation is based on two publications in high-quality per reviewed journal where Abdul Wafi is the first author. This meets the expectations of the Doctoral School of Chemistry and Environmental Sciences of University of Pannonia.

The 106-page dissertation is proportional in its structure. The "1. Introduction" (2 pages) and "2. Objective" (2 pages) sections are clear; the topic is interesting and actual. The "3. Literature Review" (23 pages) has a very logical structure; it is comprehensive, intensive, critically evaluated and well related to work presented in the dissertation. The "4. Experimental" part (7 pages) is sufficiently detailed. The methods used to prepare the photocatalyst are relatively simple; the starting materials are relatively inexpensive, which is advantageous for practical implementation. The chosen methods of physical-chemical characterization were well suited for the analysis of the prepared samples. The

photocatalytic measurements are well planned and carried out carefully. The "5. Result and Discussion" (44 pages) section is easy to follow and well understandable; the conclusions are well established. Candidate compares his own results with literary analogies; he supports his conclusions with literature examples. The "6. Summary" (2 pages) section highlights the important new knowledge gained as a result of the work. 206 literature references used demonstrate the candidate's proficiency in the topic; the literature references are correct formally.

The dissertation is written in a good style, it contains only a few grammatical and spelling errors *e.g.* „high annealing (Fig. A5.5)" probable is "high temperature annealing" (page 61).

The figures and tables in the dissertation are clear and informative. The appearance of the dissertation is attractive.

My questions which are related to the material and the topic presented in the dissertation are the following:

- What role does surface plasmon resonance play for Ag/TiO_2 catalysts in general and in the own system?
- What is the probable reason why the highest antibacterial effect can be observed at the lowest Ag load?
- What does the Candidate think about the recyclability of photocatalysts in general and in the own system?
- To the Candidate's knowledge, is doped TiO_2 already used in practice (processes, patents, etc.)?

I accept the theses as new results. After successful doctoral defense I recommend that the Candidate is awarded the doctoral degree.

Budapest, June 7, 2021

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