

SILESIAIAN UNIVERSITY OF TECHNOLOGY

**Faculty of Chemistry
Department of Organic Chemistry, Bioorganic Chemistry and
Biotechnology**

Tomasz Wasiak, MSc

Doctoral Dissertation

***New generation of catalysts based on
nanomaterials for advanced organic chemistry***

Supervisor: Dr. Dawid Janas, prof. SUT

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Abstract

Nanotechnology has revolutionized many aspects of modern science and industry. The discovery of unique properties of nano-sized particles resulted in numerous improved processes and applications. Thanks to quantum effects, well-developed surfaces, and almost endless possible compositions and morphologies, nanomaterials revealed new research opportunities. Among various nanomaterials, metal-based nanoparticles of different shapes are particularly interesting due to their hidden potential, which can be exploited in catalysis. Especially, anisotropic nanostructures like nanowires attract attention as their specific morphology enhances some of their properties.

As most chemical reactions used on a large scale are catalyzed by transition metals in bulk forms, it is expected that alternative solutions based on nanomaterials may provide even better performance. Lower noble metal load, higher activity, and better stability are key targets for scientists in this field. This work focuses on nanomaterial implementation to make highly efficient catalytic systems for organic chemistry transformations. During this research, nanowires were used as base structures for catalyst preparations. The conducted work includes their synthesis, characterization, application in nanocomposites with spherical nanoparticles of noble metals, and evaluation of their catalytic activity.

The dissertation is composed of a collection of monothematic articles, begins with a description of current knowledge about nanowires, their synthesis, and benefits and unresolved issues connected with nanowire application in catalysis. Then, an example of an ecological approach is presented that exploits industrial wastewater, rich in heavy metals, as a precursor of nanowires. Further parts of the thesis show the application of catalytic systems that utilize metallic nanowires and nanoparticles. Based on abundant non-noble metal nanowire structures decorated with highly active noble metal species, efficient catalysts were obtained and tested in advanced organic chemistry transformations.