



# MONOGRAPH

## 9<sup>TH</sup> EUROPEAN YOUNG ENGINEERS CONFERENCE



**Faculty of Chemical  
and Process Engineering**  
WARSAW UNIVERSITY OF TECHNOLOGY

**Warsaw University  
of Technology**



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# MONOGRAPH

9th European  
Young Engineers  
Conference

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## 12.7 Photoluminescence properties of carbon nanoparticles synthesized by laser ablation in water and aqueous solutions of amine-based reagents

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KEYWORDS: *pulsed laser ablation in liquids, carbon nanoparticles, optical properties.*

The comparison between two synthesis routes for obtaining carbon nanoparticles (CNPs) in water and in aqueous solutions of amine-based reagents is presented. The influence of synthesis approach and parameters on structural and luminescent properties of CNPs is discussed.

Each of the synthesis routes was a two-step process. In the first approach, the graphite target submerged in water was ablated using moderate fluence of a laser beam. Next, a certain amount of aqueous reagent solution was added to the suspension of carbon particles. Such a mixture was then exposed to a much stronger laser beam in order to reduce the size of particles. In contrast to the first approach, during another synthesis route the graphite target was immersed in aqueous reagent solution and exposed to laser irradiation. The obtained suspension of carbon nanoparticles was further irradiated without the presence of graphite target.

Luminescence and absorbance studies revealed interesting properties of obtained colloids. Suspension of particles produced in pure water after first step is yellowish and has some absorbance in whole spectrum rising as the wavelength decreases. After second step it is colourless and fully transparent in visible light and has high absorbance in UV with distinct maximum about 285 nm. The addition of the reagent at the second step of the synthesis leads to location of absorbance maximum at about 285 nm. However, using amine-based solution from the beginning causes high absorbance in the whole spectrum without any distinctive maximum. It may indicate the simultaneous creation of different carbon structures and fluorescent molecules during laser ablation process.

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## 12.8 Corrosion resistance of spinels with different MgO:Al<sub>2</sub>O<sub>3</sub> molar ratio in contact with steel slag

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KEYWORDS: *refractories, corrosion, spinel, steel slag, microstructure.*

The steel industry requires continuous improvement of castables quality. Spinel has a significant influence on the properties of castables. The main phenomena causing degradation of the refractory material is slag corrosion. It results from the difference of chemical substances between slag and refractory material. The stoichiometric spinel MgAl<sub>2</sub>O<sub>4</sub> is the only stable compound in the MgO-Al<sub>2</sub>O<sub>3</sub> system that melts congruently at 2105 °C. It has excellent corrosion resistance as well as a high melting point. Among other things, these properties mean that it is used in used castables, for example in the metallurgical industry for lining thermal devices or steel ladles. Spinel tends to replace both aluminum and magnesium cations with other cations of similar size, while maintaining electrochemical balance. Spinel undergoes structural changes in contact with slag. For example, chromium ions can replace aluminum ions in the spinel structure, while iron ions can replace both aluminum and magnesium ions in the spinel structure. Crystalline lattice vacancies may arise. The low-melting phases formed in contact with the slag also have a negative impact.

The aim of the study was to determine the effect of MgO content in the spinel on the corrosion resistance of the tested spinels. The study was carried out with the use of industrial slag, on three samples differing in spinel stoichiometry: MgO-rich spinel, stoichiometric spinel and Al<sub>2</sub>O<sub>3</sub>-rich spinel. The corrosion resistance was verified on the basis of tests using the contact method. Using the SEM-EDS technique, the microstructure of the tested samples after corrosion was determined. Based on the pictures of the sample cross-sections and calculations made in the MATLAB calculation program, the corrosion coefficient IC was determined. An XRD analysis of the tested samples was also performed. Spinel rich in MgO is characterized by higher sinterability and is strongly resistant to basic slags.

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