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Book of Abstracts

The 11th Torunian Carbon Symposium

Copernican revolution in carbon science

Welcome

It is a great honor to welcome you to the XI th Torun Carbon Symposium. It has been organized since 1992 by the Polish Carbon Society (ptw.edu.pl). The eleventh edition (TCS 2024) falls one year after the celebration of the Copernican year (2023) and one year before the 40th anniversary of the discovery of fullerenes (1985). The theme of the conference - Copernican Revolution in Carbon Science - is a reference to these anniversaries. The concept of fullerenes was difficult for skeptics to accept because it required acceptance of the presence of complex carbon structures in nature. The fullerene hypothesis and experimental evidence of its existence changed the way of thinking about carbon, which in "the pre-Copernican paradigm" could only exist in two allotropic varieties - diamond and graphite. "The post-Copernican paradigm" in carbon science has resulted in the synthesis of new carbon materials with reduced dimensionality, including nanotubes and graphene, exhibiting a spectrum of impressive properties, so to speak, opening up the field of nanotechnology. The change in thinking has led to development of a wide spectrum of materials with reduced dimensionality that revolutionize science and technology.

The conference will discuss achievements and new challenges facing carbon materials in various allotropic forms, from 0-dimensional to 3-dimensional structures, as well as other synthetic carbon materials used in aerospace, automotive, construction, energy conversion and storage, electronics or optics. Issues related to modern applications of carbon materials in medicine or environmental protection will be discussed, as well as topics aimed at working towards reducing the negative impact of carbon-related industries on the natural environment. We really hope you enjoy the conference and that you make lots of new friends!

Paweł Schroeder
Chairman

Aneta Frączek-Szczypta
Vice Chairman

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Polypropylene nanocomposites containing carbon nanofillers for MV and HV power cables

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Cross-linked polyethylene (XLPE) is widely used as an insulation material in power cables. With recent advancements in medium and high-voltage power transmission and distribution, there is a growing need for new insulation materials that offer high performance, recyclability, and high operating temperatures as alternatives to traditional XLPE insulation. Polypropylene (PP) has shown excellent properties, making it an attractive candidate for medium and high-voltage direct current insulation and screening (Figure 1) [1,2]. It belongs to the group of polyolefins which can be obtained through the process of polymerization of propylene monomers. PP can be found in three stereo-specific configurations based on the attachment of methyl group (–CH3) on the polymer backbone (syndiotactic, isotactic, and atactic) [1]. The intrinsic high melting temperature of PP allows it to carry high voltages and withstand higher working temperature thus avoiding the use of crosslinking agents. Moreover, PP does not have impurities problems like XPLE and this favours the dielectric properties of PP [1]. Therefore, with respect to XLPE, PP shows the advantages of enhancing thermal and electrical properties, no by-product formation, no degassing treatment requirement, and is recyclable [1].

Thus, developing PP-based MV and HV power cable insulation and screens with enhanced electrical, thermal, and mechanical properties is crucial for finding a recyclable insulation material. The advancements in nanodielectrics suggest that nanotechnology could significantly improve the overall dielectric properties of PP-based materials. This work explores the key aspects of PP-based nanocomposites for MV and HV power cables, with a focus on how different nanofiller parameters affect the dielectric, and mechanical properties, as well as the water treeing effect. Based on the collected information, future directions for enhancing the properties of PP-based nanocomposites for MV and HV power cables will be discussed.

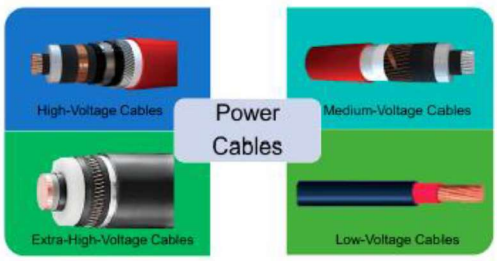

Figure 1. Different types of power cables used for electricity transmission and distribution [2].

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