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The influence of the chemical structure of synthetic hydrocarbons and alcohols on the tribological properties of diesel and jet fuels

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The aim of this paper is to present the latest tribological data concerning the mechanism of protective film formation by fuels containing synthetic hydrocarbons and alcohols. The fuels were tested using HFRR and BOCLE methods. The criterion for fuel lubricity in the HFRR and BOCLE tests was the ball wear. The HFRR tester was also capable of measuring the film thickness. The analyzed fuels for diesel and turbine engines consisted of mineral fuel and three series of synthetic compounds, i.e., paraffinic hydrocarbons with an even number of carbon atoms in the chain, paraffinic hydrocarbons with an odd number of carbon atoms and isomers of butanol. The synthetic compounds were added to the mineral fuel at a concentration of 0-20% (v/v). All the fuels tested contained commercially available lubricating additives (carboxylic acids). The addition of the synthetic compounds to the mineral fuel had two effects: diluting the lubricating additives and changing the intermolecular interactions of the base fuel (with no additive). Both effects were considered while analyzing the test results. The experimental data were studied taking into account the conclusions drawn from the αi model described by Kajdas, Kulczycki and Ozimina. The analysis revealed that the liquid phase i.e., the protective film should consist of agglomerates or clusters of hydrocarbon molecules, which are responsible for the transfer of energy in the form of electrons triboemitted from a metal surface to the molecules of the lubricating additives. The proposed mechanism can explain the influence of the base fuel on the effectiveness of the lubricating additives.

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Carbon nanostructures for energy storage applications

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Sustainable and renewable energy sources from hydropower, solar, and wind power are expected to release the heavy burdens on the current energy infrastructure and the environmental concerns. As these renewable energy sources such as solar and wind power are intermittent in nature, reliable electrochemical energy storage systems, mainly including rechargeable batteries and electrochemical capacitors, are purposely explored to promote efficient utilization of these energy sources and are a growing challenge. The development of high energy storage devices has been one of the most important research areas in recent years and relies mostly on the successful engineering of electrode materials. Carbon nanostructures such as carbon nanotubes (CNTs) and graphene have been full of surprises since their emergence and are intensively investigated for use as electrode materials in energy storage devices. Utilizing CNTs, graphene, and their composites for various energy storage applications such as Li-ion and L-S batteries, and supercapacitors are under scrutiny because of their improved electrochemical activity, cost effectiveness, environmental benign nature, and promising electrochemical performance. In this presentation, the author will discuss their research strategies and efforts to employ carbon nanostructures for different energy storage applications including flexible and even stretchable electricity storage devices.

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