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GRAPHENE AS A MATERIAL FOR ENERGY APPLICATIONS

Professor Łukasz Kaczmarek,
Piotr Kula, Konrad Dybowski, Piotr Zawadzki, Magdalena Balik, Ilona Acznik, Piotr Kosobudzki, Mariusz Stegliński, Radomir Atraszkiewicz, Hieronim Szymanowski, Bartłomiej Januszewicz, Grzegorz Romaniak
Lodz University of Technology, Lodz, Poland
Email:lukasz.kaczmarek@p.lodz.pl

Geopolitical changes in Europe have caused, among others, energy crisis and the need to introduce changes in the supply chain of oil and gas, as well as coal. For this reason, intensive search for solutions to achieve energy independence with the use of Renewable Energy Sources began. Unfortunately, technical infrastructure has become a technical limitation, the limitations of which make it impossible to collect the surplus of energy produced.

On the other hand, energy banks in the form of hydrogen storages are also at a relatively low level of advancement (except for high-pressure solutions). This fact significantly limits the development of modern systems for generating and storing energy from renewable energy sources. For this reason, high hopes are placed in graphene and materials produced on its basis with quasi2D properties of graphene not only in the field of energy, but also in relation to improving the quality of life (clean water and health).

Rising silicon prices led to the search for its substitutes. One such proposal is graphene quantum dots (QGD). The research conducted at the Institute of Materials Science and Engineering of the Lodz University of Technology led to the development of a method for producing QGD from natural precursors (extracts of fruits, vegetables, leaves or cut grass) and the construction of flexible and transparent photovoltaic cells based on them, the efficiency of which is currently at the level of several %. In this case, the ability to produce any large cell surface and its low cost is the main advantage compared to the currently used silicon wafers.

Conclusion & Significance:

The 3D material created using the oxidized form of graphene made it possible to achieve a hydrogen storage degree of 1% by weight.

Another example are the processes of synthesis of graphene materials for the construction of Li-ion battery electrodes. The conducted galvanostatic tests showed that the material with finer crystallites, fewer graphene layers, higher degree of oxidation and defect reached a higher value of electrochemical capacitance. For this material, after the functionalization process, we have achieved an electric capacity of 1080 mAhg-1, which is almost three times higher than the value recorded for commercially used graphite anodes.

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INTEGRATIVE LIGHTING

Nazarenko Leonid,
Doctor of Sciences, professor;
Didenko Olena,
PhD,
Felonenko Dmytro,
graduate student
O. M. Beketov National University of Urban Economy in Kharkiv
E-mail: leonnaz@ukr.net

Over the past 25 years, research concerning the human responses to light has been largely expanded, and currently, there is strong scientific evidence that light is not only essential for vision, but it also affects the biological functioning of people and has an important impact on human health and performance. Numerous studies have demonstrated that light also influences circadian rhythms and neurobehavioral responses. These types of responses have been defined as "non-image – forming" (NIF) effect of light. Non-visual effects are mediated by signals from retinal photoreceptors, i.e. from circuits of rods, cones and intrinsically photosensitive retinal ganglion cells (ipRGCs). These retinal photoreceptors are specialized ganglion cells that contain the photopigment "melanopsin" and are intrinsically sensitive to light spectrum. Their peak sensitivity (approx. 460-480 nm) occurs at a shorter wavelength compared to that of rods (at 507 nm) and cones (at 555 nm) suggesting the relevance of the spectral distribution as a factor that influences non-visual effects of lights.

Considering the relevant impact of non-visual response to light on human health and well-being significant research, has been carried out, which led to the proposition of new, dedicated circadian metrics to estimate and quantify non-visual effects of light.

Up-to-date there main approaches have been proposed: The Circadian stimulus (CS) model, The "Equivalent Melanopic Lux (EML)", The melanopic Equivalent Daylight Illuminance (m-EDI).

The "Circadian stimulus" model was proposed by Rea and Figueiro and indicates the human responses to light in terms of the percentage of melatonin suppression. CS is defined as the calculated effectiveness of the spectral weighted irradiance at the cornea from threshold (CS=0,1) to saturation (CS=0,7), assuming a fixed duration of exposure of 1h. According to indications provided by Figueiro, a CS value of 0,3 or greater at the eye during the morning is suitable for the promotion of good circadian entertainment. The target threshold values are reduced to a maximum of 0,2 in the evening and a maximum of 0,1 during the night.

The "Equivalent Melanopic Lux"(EML) is based on the spectral sensitivity of the melanopsin photoreception of ipRGCs with reference to the illuminant E (an equal-energy illuminant) and is based on studies connected by Lucas and Enezi.