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High strength metallurgical graphene (HSMG®): Prospects for application in functional laminates and sensors

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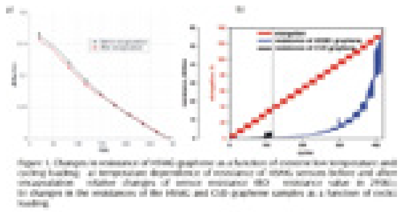
Effective practical application of products made of graphene as the base material are contingent on the development of methods of manufacturing large-area graphene on an industrial scale, the structure and properties of which would be similar to theoretical ones. At the Lodz University of Technology, an original industrial method was developed of producing large-area sheets of graphene through its controlled growth from metallic liquid phase. Graphene produced this way is close to structural perfection, i.e. it is single-layered and quasimonocrystalline, which results in its very high cohesion confirmed in static and cyclic tests of tensile strength. The authors of the 2D material produced in this manner called it "High Strength Metallurgical Graphene"–HSMG®. Also disclosed were two alternative growth mechanisms of graphene from the liquid metallic phase, i.e. dendritic and cellular, which produce HSMG with different electrical properties–respectively conductive graphene (c-HSMG), and semiconductive graphene (sc-HSMG). The capabilities of HSMG® were indicated with respect to selective adsorption and chemisorption of gases-in particular hydrogen-from gas mixtures. With the described mechanical and physical properties, high strength metallurgical graphene is ideal for application as the reinforcing phase and at the same time functionally active phase in laminates. HSMG can be repeatedly transferred between different substrates; this offers prospects of supervised control over the distance between successive reinforcement layers in the polymer matrix. A separate area of potential application of HSMG® is sensing of gases and electromagnetic radiation. The success of graphene as an engineering material of the future depends on the creative creation of new generation devices, rather than on strenuous attempts we have seen so far to replace other components with graphene in pre-existing design solutions and technologies.



Biography

P Kula, PhD, DSc, is the President of Polish Materials Society, a Member of European Materials Science Society (FEMS) and American Society for Metals. He has been the Head of Materials Science and Engineering Institute at Lodz University of Technology since 1997. Since then, he has founded and developed a strong research team in the field of Surface Engineering and Nanotechnology, recognized as the Lodz School. His main scientific and research achievements are non steady state models of vacuum carburizing and vacuum nitriding, artificial intelligence based software that supports these processes on the industrial scale and recently the manufacturing technology of high strength metallurgical graphene (HSMG) as well as the concept of using HSMG to produce the graphene-based nanocomposite for reversible storage of hydrogen.

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