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Extended Abstract
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Chemistry Congress2019: The chemistry of graphene and its inorganic analogues - Zdenek Sofer

Zdenek Sofer
University of Chemistry and Technology Prague, Czech Republic

The chemistry of graphene is growing rapidly in last decade and broad range of graphene derivates was prepared. Nevertheless, only two stoichiometric derivates are currently known: hydrogenated and fluorinated graphene (graphane and fluorographene). Compared to graphene, these materials exhibit significantly different properties, e.g. higher reactivity as well as large differences in physical properties. Especially fluorographene can be applied as a substrate for nucleophilic substitution reactions, which significantly extend the possible chemical modifications of graphene. Currently, the chemistry of the other 2D materials starts to be explored. However, the chemistry of inorganic 2D materials like pnictogens and transition metal dichalcogenides is not well known and only several procedures were already reported. In comparison with graphene, new synthetic protocols have to be applied because the chemistry of these materials is extremely variable. In the case of transition metal dichalcogenides, the formation of the M-X-C bond (M is a metal, X is any chalcogenide) can be used as a starting point for exploring their chemistry and for further derivatisation. The chemistry of layered pnictogens is significantly different. In this case, various reactions including nucleophilic substitution can be applied, however, the bonding through the oxygen functionalities on pnictogen surface is observed in many cases.

Graphene is that the only sort of carbon (or solid material) during which every atom is out there for reaction from two sides (due to the 2D structure). Atoms at the sides of a graphene sheet have special chemical reactivity. Graphene has the very best ratio of edge atoms of any allotrope. Defects within a sheet increase its chemical reactivity. The onset temperature of reaction between the basal plane of single-layer graphene and oxygen gas is below 260 °C (530 K). Graphene combusts at 350 °C (620 K). Graphene is usually modified with oxygen- and nitrogen-containing functional groups and analyzed by infrared spectroscopy and X-ray photoelectron spectroscopy. However, determination of structures of graphene with oxygen-and nitrogen- functional groups requires the structures to be controlled. Contrary to the perfect 2D structure of graphene, chemical applications of graphene need either structural or chemical irregularities, as perfectly flat graphene is chemically inert. In other words, the definition of a perfect graphene is different in chemistry and physics.

Soluble fragments of graphene are often prepared within the laboratory[through chemical modification of graphite. First, microcrystalline graphite is treated with an acidic mixture of vitriol and aqua fortis . A series of oxidation and exfoliation steps produce small graphene plates with carboxyl groups at their edges. These are converted to acid chloride groups by treatment with thionyl chloride; next, they're converted to the corresponding graphene amide via treatment with octadecylamine. The resulting material is soluble in tetrahydrofuran, tetrachloromethane and dichloroethane.

Nucleic acid analogues are compounds which are analogous (structurally similar) to present RNA and DNA, utilized in medicine and in biology research. Nucleic acids are chains of nucleotides, which are composed of three parts: a phosphate backbone, a pentose sugar, either ribose or deoxyribose, and one among four nucleobases. An analogue may have any of those altered. Typically the analogue nucleobases confer, among other things, different base pairing and base stacking properties. Examples include universal bases, which may pair with all four canonical bases, and phosphate-sugar backbone analogues like PNA, which affect the properties of the chain (PNA can even form a triple helix). macromolecule analogues also are called Xeno macromolecule and represent one among the most pillars of xenobiology, the planning of new-to-nature sorts of life supported alternative biochemistries. Artificial macromolecule s include peptide nucleic acid (PNA), Morpholino and locked macromolecule (LNA), also as glycol macromolecule (GNA) and threose macromolecule (TNA). Each of those is distinguished from present DNA or RNA by changes to the backbone of the molecule.

Inorganic polymers are polymers with a structure that doesn't include carbon atoms within the backbone. Polymers containing inorganic and organic components are sometimes called hybrid polymers, and most so-called inorganic polymers are hybrid polymers. one among the simplest known examples is polydimethylsiloxane, otherwise known commonly as synthetic rubber . Inorganic polymers offer some properties not found in organic materials including low-temperature flexibility, electrical conductivity, and nonflammability. The term inorganic polymer refers generally to one-dimensional polymers, instead of to heavily crosslinked materials like silicate minerals. Inorganic polymers with tunable or responsive properties are sometimes called smart inorganic polymers. A special class of inorganic polymers are geopolymers, which can be anthropogenic or present.

Graphene has been the foremost studied. In small quantities it's available as a powder and as dispersion during a polymer matrix, or adhesive, elastomer, oil and aqueous and non-aqueous solutions. The dispersion is claimed to be suitable for advanced composites, paints and coatings, lubricants, oils and functional fluids, capacitors and batteries, thermal management applications, display materials and packaging, inks and 3D-printers' materials, and barriers and films.

Research on 2D nanomaterials remains in its infancy, with the bulk of research that specialize in elucidating the unique material characteristics and few reports that specialize in biomedical applications of 2D nanomaterials. Nevertheless, recent rapid advances in 2D nanomaterials have raised important yet exciting questions on their interactions with biological moieties. 2D nanoparticles like carbon-based 2D materials, silicate clays, transition metal dichalcogenides (TMDs), and transition metal oxides (TMOs) provide enhanced physical, chemical, and biological functionality due to their uniform shapes, high surface-to-volume ratios, and surface charge.