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New catalytic application of modified graphene in synthesis of biologically active heterocycles

Saeid Khodabakhshi
IMDEA Nano Science Institute, Spain

So far, various heterogenous catalysts have been used for organic reactions, but metal-free catalysts have attracted much attention in recent years. Metal-free carbon-based catalysts have some advantages over metal catalysts, such as high efficiency, environmental compatibility, low energy consumption, and corrosion resistance. Among metal-free materials having catalytic properties, carbon-based catalysts such as modified graphene and nanotubes are emerging. Using graphene oxide (GO) as non-oxidative catalysts to promote and facilitate organic reactions in particular the condensations of the active methylenes is a new area with outstanding potential. In fact, the acidic nature of GO provides active sites to promote organic reactions which need the mild acidic conditions. GO and its related materials have some advantages over many common catalysts including stability, safety, insolubility in common solvents, and recyclability make them recyclable catalysts for many chemical reactions. However, the catalytic application of graphene has focused primarily on the use of these materials as a support for catalytically active transition metals. Despite the merits of graphene materials, their application as catalyst in synthetic chemistry remains unexplored. Accordingly, here we explain the use of GO as a metal-free, eco-friendly and recyclable catalyst for the convenient synthesis of some biologically active compounds containing aryloyl group in green conditions. The reaction of 4-hydroxycoumarin with aryl glyoxals and malononitrile in the presence of graphene oxide provides a simple one-pot entry to the synthesis of some biscoumarins and pyranocoumarins of potential pharmaceutical and synthetic interest. The present methods have some advantages such as the use of a safe and recyclable catalyst, avoidance of toxic solvents, high product yields, short reaction times, and an easy work-up procedure.

saeidkhm@yahoo.com

Bio-inspired synthesis and self-assembly of few layer graphene

Izabela Janowska
Institute of Chemistry and Processes for Energy, Environment and Health, France

The future development of advanced materials depends on several aspects, which are first of all linked to synthesis and then exploitation of the materials in an efficient way. This concerns also the graphene based materials and despite the huge number of efforts devoted to the synthesis of graphene and few layer graphene (FLG) there is still luck of the methods allowing their high scale production together with environment respect. Their efficient use in composites, polymers and films in order to provide or enhance graphene-related properties such as high conductivity, transparency, flexibility, mechanical resistance will depend on the way these "nano" materials are arranged in the macroscopic media. Herein, the bio-compatible, high yield production of solution processable FLG is presented together with a new approach of bio-inspired FLG self-assemblies into fractal like patterns (presently under patent application). Such FLG self-assemblies reduce the percolation threshold between FLG flakes allowing the percolation at lower amount of FLG for a given surface if compared to the random arrangement (fig.1). This can find the application in transparent conductive films (TCF), where the FLG self-assemblies patterns can be optimized in order to achieve variable transparency-conductivity properties according to the TCF final use. This interesting finding recalls the natural tendency of matter to self-organize into functional systems. The fractal like, branched structures are commonly observed in numerous natural systems being in charge of transport function, such as river beds, trees or neural system.

janowskai@unistra.fr