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Author: Ali Shaygan Nia Wolfgang H. Binder

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<AT>Graphene as initiator/catalyst in polymerization chemistry

<AU>Ali Shaygan Nia, and Wolfgang H. Binder*
##Email##wolfgang.binder@chemie.uni-halle.de##/Email##
<AFF>Macromolecular Chemistry, Institute of Chemistry, Division of Technical and Macromolecular Chemistry, Faculty of Natural Science II (Chemistry, Physics and Mathematics), Martin-Luther-University Halle-Wittenberg, -Danckelmann-Platz [4,] Halle D-06120, Germany

<PA>Tel.: +49 (0) 345 55-25930.

<ABS-HEAD>**Abstract**

<ABS-P>One of the most important applications of graphene-based materials is the formation of nanocomposite materials, where graphene in the bulk-polymer matrix transfers its properties onto the polymeric material. Control of the polymer/graphene interface by attached polymeric interlayers is essential to generate nanocomposites, thus avoiding the aggregation of graphene nanoparticles. Among all graphene materials graphene oxide (GO) and reduced graphene oxide (r-GO) can be prepared on large scales useful for mass production graphene/polymer composites. The direct use of graphene materials as both, the polymerization initiator or catalyst and additive not only diminishes the agglomeration of particles in composites but also reduces the process of composite production to one facile step, which in turn avoids further purification regarding to strong acid initiators and metal particles catalysts. Here, literature activities within the past ~10 years using graphene-based materials either as initiator or catalyst in different polymerization reactions are reviewed.

<KWD>Keywords: Graphene; polymerization; initiator; catalyst; thermoset

<KWD>Abbreviations: AAS, Atomic absorption spectroscopy; AFM, Atomic force microscopy; AIBN, Azobisisobutyronitrile; $AgNO_3$, Silver nitrate; $AlEt_3$, Triethylaluminium; Al_2O_3, Aluminium oxide; APTMS, (3-Aminopropyl)trimethoxysilane; APTS(APTES), (3-Aminopropyl)triethoxysilane; BuLi, Butyllithium; BuMgCl, Butylmagnesium chloride; CNT, Carbon nanotubes; $Co(OAc)_2.4H_2O$, Cobalt(II) acetate; Cp_2ZrCl_2, Bis(cyclopentadienyl)zirconium dichloride; CuAAC, Copper catalyzed azide-alkyne click reaction; $Cu(acac)_2$, Copper (II) acetylacetonate; CuBr, Copper (I) bromide; $CuCl_2$, Copper(II) chloride; Cu/C, Copper on charcoal; $Cu(NO_3)_2.3.H_2O$, Copper(II) nitrate trihydrate; Cu_2O, Copper(I) oxide or cuprous oxide; CuO, Copper(II) oxide or cupric oxide; $Cu(OAc)_2$, Copper(II) acetate; $Cu(OH)_2$, Copper(II) hydroxide; $CuSO_4$, Copper(II)sulfate; CVD, Chemical Vapor Deposition; DCC, *N,N′*-Dicyclohexylcarbodiimide*;* DCM, Dichloromethane; DDS, 4,4'-Diaminodiphenylsulfone; DMAP, 4-Dimethylaminopyridine; DMF, *N,N*-Dimethylformamide*;* DMSO, Dimethyl sulfoxide; DSC, Differential scanning calorimetry; EDTA, Ethylenediaminetetraacetic acid; EDX,EDS,XEDS, Energy-dispersive X-ray spectroscopy; EtOH, Ethanol; EPR, Electron paramagnetic resonance; FAAS, Flame atomic absorption spectroscopy,; fcc, face centered cubic; $FeCl_3$, Iron(III) chloride; $Fe(NO_3)_2.9.H_2O$, Iron(III) nitrate nonahydrate; Fe_2O_3, Iron(II) oxide; FTIR, Fourier transform infrared spectroscopy; FWHM, Full width at half maximum; GPC, Gel permeation chromatography; $HAuCl_4$, Chloroauric acid; HEBrIB, 2-Hydroxylethyl 2-bromoisobutyrate; H_2PdCl_4, Tetrachloropalladinic acid; H_2PtCl_6, Chloroplatinic acid; HRTEM, High resolution transmission electron microscopy; ICP-AES, Inductively coupled plasma atomic emission spectroscopy; ICP-MS, Inductively coupled plasma mass spectrometry; IL, Ionic liquid; K_2CO_3, Potassiumcarbonate; $KMnO_4$, Potassiumpermanganate; K_2PdCl_4, Potassiumtetrachloropalladate(II); MMA, Methyl methacrylate; MAO, Methyl ammonium oxide; MeOH, Methanol; $Mn(OAc)_2.4H_2O$, Manganese(II) acetatetetrahydrate; MW, Microwave irradiation; $NaBH_4$, Sodiumborohydride; NaH, Sodiumhydride; N_2H_4, Hydrazine; NHC, *N*-Heterocyclic carbene*;* $Ni(OAc)_2.4H_2O$, Nickel(II) acetatetetrahydrate; NMR, Nuclear magnetic resonance; NO_2, Nitrogen dioxide; N_2O_4, Dinitrogen tetroxide; NP, Nanoparticles; PA6,