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Mechanochemically aminated multilayer graphene for carbon/polypropylene graft polymers and nanocomposites

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Abstract. The two-stage mechanochemical amination of graphite by dry ball milling of graphite in a planetary ball mill under Ar followed by NH_3 yields aminated multilayer graphene (AMFG) as intermediates for carbon/polymer hybrids and nanocomposites. Opposite to efficient edge-selective graphene functionalization under Ar, CO_2 and N_2 pressure, the one-stage ball milling under NH_3 pressure affords rather low N content (<0.5 wt%) and fails to reduce the graphite platelet size. According to DFT (Density Functional Theory) calculations NH_3 exhibits low mobility between graphene layers and forms weak bonds to carbon which impair breakage of carbon bonds. In the two-stage ball-milling of graphite under Ar affords reactive carbon nanoparticles which react with NH_3 in the second stage. With increasing milling duration of the second stage the nitrogen content increases to 3.2 wt%. As verified by XPS (X-ray photoelectron spectroscopy) measurements primary amine groups are formed which couple with various dicarboxylic anhydride groups including maleated PP to produce imide-functionalized graphene. This is of interest to produce compatibilizers and dispersing agents for carbon/PP nanocomposites exhibiting improved mechanical properties. Two-stage mechanochemistry holds promise for carbon nanoparticle functionalization well beyond amination.

Keywords: *nanocomposites, carbon, mechanochemistry, graphene, amination*

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