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Structural and chemical features of magnetic graphene oxide for wastewater treatment

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Magnetic graphene powders were prepared by decorating graphene oxide synthesized by the Hummers method with iron oxide nanoparticles by a solvothermal method. Different synthesis and reducing conditions were assayed in order to study its influence on the methylene blue discoloration capacity. Kinetic tests were conducted at different MB concentrations during 60 min under agitation. After the discoloration period, the powders were recovered using a permanent magnet (Figure 1). A test for metal absorption was conducted by using a metal standardized analytical solution. The initial test showed absorption capability for Al, Si, P after the EDS measurements and the formation of clusters on the graphene sheet was observed by SEM (Figure 2).To asses the possible difference in the discoloration power related with the different synthesis and post treatment conditions, powders were characterized by X-ray diffraction, Raman spectroscopy, Fourier Transform Infrared Spectroscopy, Scanning Electron Microscopy and Energy Dispersive Spectroscopy. X-ray diffraction showed the presence of Fe_3O_4 and Fe2O3 in the samples prepared at the lowest pH assayed. Correspondingly, at higher pH the presence of FeOOH is evident in the XRD. Infrarred spectra suggest that GO sheets are decorated mainly in the carboxylic groups (Figure 3). Raman spectroscopy shows an increment in the disorder (Figure 3) within the decoration that is related with the destruction of the graphene sheet observed by SEM (Figure 4). Interestingly, depending on the reducing conditions, carbon nanotubes are formed. A 5-fold difference in discoloration capacity was observed depending on the synthesis and post treatment conditions. The prepared magnetic graphene oxide materials are shown to be a promising alternative in water treatment for removal of organic and inorganic pollutants.