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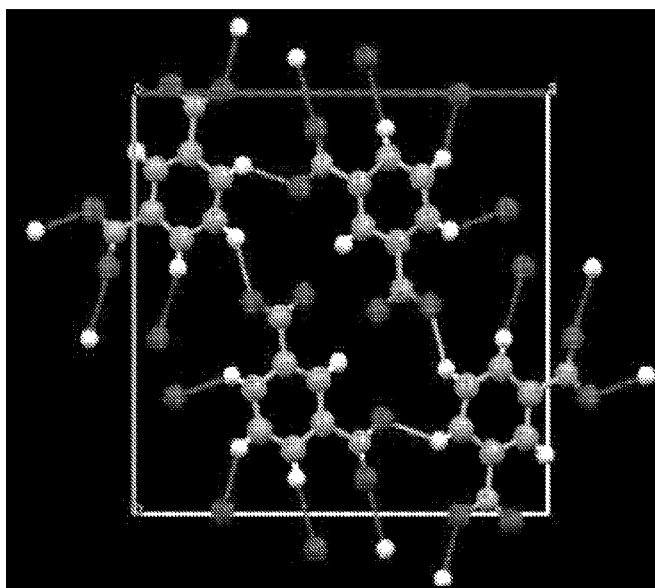


FIG. 19

(57) Abstract: Embodiments described are directed to methods for the functionalization of asphaltene materials and to compositions made from functionalized asphaltenes. Disclosed is a method for synthesizing graphene derivatives, such as 2D single crystalline carbon allotropes of graphene and functional materials, such as sulfonic acid and its derivatives. Also disclosed is a method for the transformation of asphaltene into a source of graphene derivatives and functional materials, such as, 0D, 1D, 2D and combinations of 0D and 1D by utilizing chemical substitution reaction mechanism, such as, electrophilic aromatic substitution, nucleophilic aromatic substitution and Sandmeyer mechanism. Also disclosed are novel graphene materials comprising: acetylenic linkage and hydrogenated graphene. These novel materials, which may be produced by these methods, include, e.g.: 2D single crystalline carbon allotropes of graphene with asymmetric unit formulas $C_7H_6N_2O_4$, $C_6H_4N_2O_4$, $C_7H_7O_3S^-H_3O^+$, $C_7H_7O_3SH^+$, and a 2D single crystal with asymmetric unit formula $(Na_6O_{16}S_4)_n$.