Exploring hydrothermal and chemical synthesis for novel high performance linear and hyperbranched conjugated perylene polyimides and their nanocomposites preparation

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ABSTRACT: The aim of the present research is to design new high performance conjugated polyimides. The properties of the polyimides are studied as a function of the synthetic approaches i.e. chemical versus hydrothermal. Hydrothermal synthesis is the environmentally friendlier approach. The effectiveness of the two approaches is compared by investigating linear and branched polyimides synthesized by the polymerization of the perylene with di and tri-amines. The conclusion here is that the environmentally friendlier approach is as effective as the traditional synthesis using organic solvents. Additionally, nanocomposites of the polyimides were prepared by the incorporation of exfoliated molybdenum disulfide (MoS_2) followed by crosslinking of functional end groups using thermal treatment. The nanocomposites show significantly enhanced properties at low contents of MoS_2 i.e. at 0.1 wt %. Experimental and computational studies of the structure and dynamics of conjugated polyimide/MoS_2 composites suggest that the novel polyimides show interactions with MoS_2 comparing with some commercial polyimides. The interaction results in better dispersion of the nanofillers which in turn translates to nanocomposites with excellent properties. The hydrothermal synthesis of the polyimides results in materials with excellent thermomechanical properties and thus, is a promising approach in eliminating the use of polar aprotic solvents. Additionally, polymers synthesized by hydrothermal approach can be utilized to prepare nanocomposites with excellent properties.