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Research Article

Modified guaiacol-based benzoxazines for optical, aggregation-induced emission and corrosion-resistant coating applications

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Abstract

Two new kinds of modified bifunctional and trifunctional guaiacol, namely 4,4′-(bis(4-fluorophenyl)methylene)bis(2-methoxyphenol) (BBM) and 4,4′-((2-hydroxy-4-methoxyphenyl)(phenyl)methylene)bis(2-methoxyphenol) (HBM), were synthesized using guaiacol with respective keto derivatives under appropriate experimental conditions. Two series of benzoxazines were developed with BBM and HBM using various amines (dodecylamine (dda), octadecylamine (oda), furfurylamine (ffa), aniline (a) and 4-fluoroaniline (fa)) with paraformaldehyde through Mannich condensation with a view to utilize them for anticorrosive and optical resistant coating applications. The molecular structures of the synthesized precursors and benzoxazine monomers were characterized using appropriate analytical techniques. The polymerization temperature of the benzoxazines was assessed using differential scanning calorimetry. Among the benzoxazine monomers synthesized, the monomer HBM-fa exhibits the lowest curing temperature (217 °C). Data obtained from thermogravimetric analysis indicated that the polybenzoxazines poly(BBM-ffa) and poly(HBM-ffa) possess higher thermal stability (455 and 425 °C) and higher char yield (54% and 60%) than the other polybenzoxazines. In both series, octadecylamine-based polybenzoxazines (BBM-oda and HBM-oda) exhibited the highest values of water contact angle of 148° and 149° respectively. Additionally, the benzoxazines showed aggregation-induced emission properties during fluorescence studies. Morphological analyses using different analytical techniques on selected polybenzoxazines were carried out before and after the corrosion process. Results from corrosion studies, i.e. Tafel and Nyquist plots, implied that the polybenzoxazines can be used as effective coating material to protect mild steels from corrosion. Data from different studies suggest that the developed benzoxazines can be used in the form of optical and anticorrosion coatings under thermally harsh and moist environments. © 2024 Society of Chemical Industry.