The design of functional macromolecules: from energy conversion to therapeutics.

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The design of organic macromolecules for a variety of technological or medical applications is explored with several cases studies ranging from energy harvesting or conversion to chemotherapy or immunotherapy.

For example organic polymers or blends of polymers and small molecules are attractive for the conversion of light into energy, or energy into light. Therefore, site isolation of light emitting chromophores within block copolymers[1] or discrete organic nanoparticles[2] may be used to create organic white light emitting diodes based on a single multichromophoric organic layer. Similarly, light absorbing conjugated macromolecules may be designed for application in photovoltaics. In this instance molecules capable of transporting electrons must be combined with hole transporting molecules in blends for which the required critical control of phase morphology is achieved through molecular design[3-4].

Organic polymers and nanoparticles also show great potential as carriers for the delivery of drugs[5] or other bioactive compounds[6]. Here again molecular design is critical to achieve the desired function with issues of biocompatibility, degradability, targeting, and rate of release coming to the fore.

References.

1. Poulsen, D.A. et al..; Site-Isolation in Phosphorescent Bichromophoric Block Copolymers Designed for White Electroluminescence. Adv. Mat. 2010, 22, 77-82.
2. Gao, H.; et al. Site Isolation of Emitters within Cross-Linked Polymer Nanoparticles for White Electroluminescence. NanoLett. 2010, 10, 1440-1444
3. Piliego, C.; et al.. Synthetic Control of Structural Order in N-Alkylthieno[3,4-c]pyrrole-4,6-dione-Based Polymers for Efficient Solar Cells. J. Am. Chem. Soc 2010, 132(22), 7595-7597.
4. Woo, Claire H.; et al. J. Am. Chem. Soc. 2010; 132(44), 15547-15549.
5. Fox, M.E. et al.; Soluble polymer carriers for the treatment of cancer: the importance of molecular architecture. Acc. Chem Res. 2009. 42, 1141-1151.
6. Cohen, Joel A. et al. Acetal-Modified Dextran Microparticles with Controlled Degradation Kinetics and Surface Functionality for Gene Delivery in Phagocytic and Non-Phagocytic Cells. Adv.Mat. 2010; 22(32), 3593-3597.