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Mimicking DNA chemistry and beyond from ladderphane to stromaphane

A ladderphane is a ladder-like polymer constituted of multiple layers of rigid linkers covalently linked to two or more polymeric backbones. The linkers can be planar aromatic, antiaromatic and macrocyclic metal complexes or three-dimensional organic or organometallic moieties. Structurally, a DNA molecule is a special kind of ladderphane, where the cofacially aligned base-pair pendants are connected complementarily through hydrogen bonding. Two norbornene or cyclobutene moieties fused with N-arylpiperidine are employed to connect covalently with rigid linkers. Ring Opening Metathesis Polymerizations (ROMP) of these monomers using the ruthenium or molybdenum catalyst gives the corresponding symmetrical double-stranded ladderphanes. Depending on the catalyst, double bonds in these ladderphanes can be either E or Z selectively. The presence of N-arylpiperidine moiety is crucial to control the isotactic stereoselectivity. The linkers in these ladderphanes are aligned coherently along the longitudinal axis of the polymer. Strong interactions between them may take place as evidenced by fluorescence quenching, excimer formation, Soret band splitting or electron hopping. Chiral helical ladderphanes are synthesized by incorporating chiral linkers. These ladderphanes can easily aggregate to form a two-dimensional highly ordered array on graphite surface up to submicron area as revealed by Scanning Transmission Microscopy (STM). Such assembly furnishes an entry to orient planar arene moieties cofacially, while each linear array of such arenes is insulated from the adjacent arrays by the polymeric backbones. Sequential polymerization of a monomer having two different polymerizable groups or replication protocol offers useful entries for un-symmetrical ladderphanes. This route furnishes template synthesis of daughter polymers with well-controlled chain lengths and polydispersity. When cyclopropene having spirally connected N-ary azetidene is used for ROMP, substituted alt-methylene-vinylene with all double bonds in trans-configuration is obtained. The stereo-specificity can be considered as mimicking proofreading and repair in DNA synthesis. Two-dimensional polymers obtained from ROMP of bicyclopentene will be presented.

Biography

Tien-Yau Luh has obtained his PhD degree from the University of Chicago in 1974. After spending two years for Postdoctoral Research at the University of Minnesota, he began his independent research at the Chinese University of Hong Kong in 1976. He moved back in 1988 to his alma mater, National Taiwan University where he has been University Chair Professor. He officially retired from his present post in August of 2016 and was appointed as Distinguished Chair Professor and Professor Emeritus. He has published 290 papers and has received numerous awards. He is also serving as a Member of the Advisory/Editorial Board for the journals like *Chemical Communications*, *Chemistry-A European Journal*, *Bulletin of the Chemical Society of Japan*, *The Chemical Record*, *Tetrahedron Letters* and *Springer Lecture Notes in Chemistry*. His current research interests include organometallic chemistry in polymer synthesis mimicking biomacromolecules and chemistry of materials.

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