Development of Multifunction Integrated Macromolecules for Molecular-Scale Electronics

Research Center for Molecular Scale Nanoscience
Division of Molecular Nanoscience

TANAKA, Shoji Assistant Professor

The concept of molecular-scale electronics is now realized for individual components such as wire, diode, switch, and memory cell, but the fabrication of complete molecular-scale circuits remains challenging because of the difficulty of connecting molecular modules to one another. Monomolecular Integration technology, which integrates the wiring, transistors, and the required passive elements on a single macromolecule, has been proposed as a promising solution to this problem. In this project we have been developing the architecture of this novel class of macromolecules and the protocols for their purposive organization on metal or semiconductor substrate surfaces.

1. Multipurpose Building Blocks for over 10 nm Long π-Conjugated System

"Stepwise synthesis" is the most flexible tool to construct tailor-made π-conjugated macromolecules with well defined functions for nanoscience and technology, however, the stepwise fabrication of over 10 nm long molecular skeleton is still a great challenge. As a solution to this problem, we have developed a series of versatile building blocks (1-2) as shown in Figure 1, which are active for typical Pd or Ni-catalyzed Ar–Ar coupling reactions. It is facile to access to a wide variety of 1–75 nm long π-conjugated macromolecules from the combination of these blocks and 1–10 nm long molecular modules so far reported (3–9). The synthetic examples are presented in Figure 2.

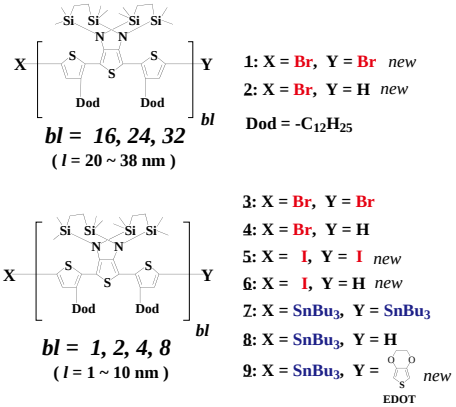

Figure 1. Molecular structures of building blocks (1-9).

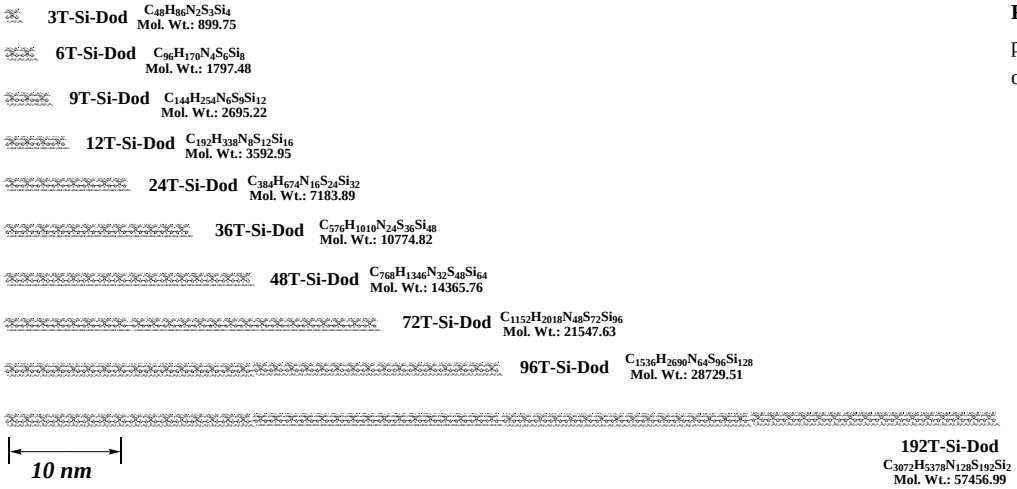

Figure 2. Synthetic examples of precisely-defined α-oligothiophene derivatives.