Intrinsic flexibility: Materials and devices

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Intrinsic flexibility originates from molecular-level deformation, such as chemical bond rotation, conformational interconversion, molecular chain extension/slip and dynamic bond formation, it is an elastic deformability providing small radius of curvature (less than 0.5 mm), high stretchability (more than 25%), and cross-scale modulus adaptability (1 kPa ~10 GPa). The ultimate goal is to achieve free-form deformation.

Technically, there are different routes for the realization of flexibility. (i) Physical flexibility: any rigid material that is extremely thin or has a very small diameter can be flexible. (ii) Structural flexibility: for example, the wire-connecting fractal and spring configuration can provide macroscopic flexibility for the rigid chip. (iii) Intrinsic flexibility: the materials (such as polymers and carbon materials) in a device have a flexible and stretchable nature. The combination of physical and structural flexibility has facilitated the development of hinge technology in folding-screen phones. However, the long-term mechanical stability of such phones is still a considerable challenge. Usually, the flexibility is quantified by the bending radius (R). A decreased R means improved flexibility of devices.

In this presentation, I will introduce a few design strategies for the realization of semiconducting molecular materials. Solution processed method is used to fabricate high-performance OFETs. Their various potential applications are also involved.