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Ferroeletricity and Double Hysteresis Loop Behavior in Even-Numbered n-Nylons[1] ZHONGBO ZHANG, LEI ZHU, MORTON LITT, Case Western Reserve Univ — Ferroelectric (FE) property in odd-numbered n-nylons has been known for a long time. In comparison, even-numbered n-nylons are claimed to be non-ferroelectric due to their non-polar crystalline structure, where the direction of hydrogen bonded dipoles alternates. Nevertheless, in this presentation, FE property is discovered in even n-nylons, and it is related to the mesomorphic crystalline structure formed via quenching and/or stretching. Although there was an earlier claim maintaining that FE behavior in melt-quenched nylon 6 was due to the amorphous phase, the conclusion is debatable and the understanding of the FE mechanism is still lacking. We find that poorly bonded amide dipoles, which result from the defective crystalline mesophase, play an important role in the FE behavior of nylon 12. In this mesophase, the chain conformation is smectic-like, twisted, and the hydrogen bonds are randomized. Therefore, this mesophase is abundant in defects and poorly bonded dipoles, which can easily flip under electric field. In addition, the hydrogen-bonded amides can serve as pinning points and induce double hysteresis loop behavior. This understanding illustrates that FE in even n-nylons originates from the defective crystalline phase rather than the amorphous region.

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